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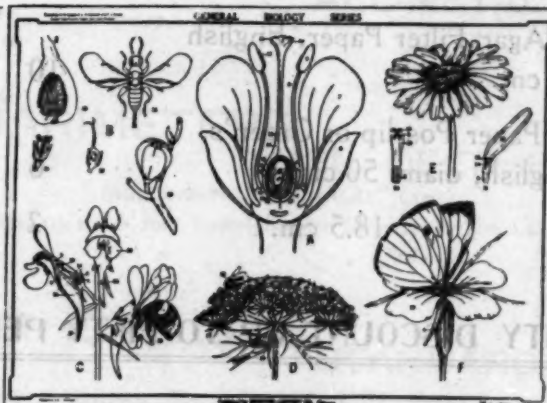


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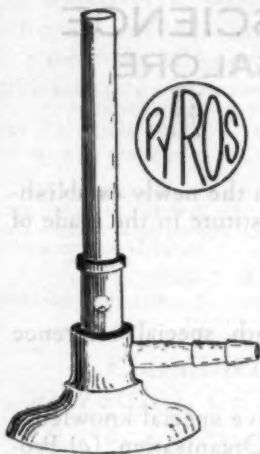
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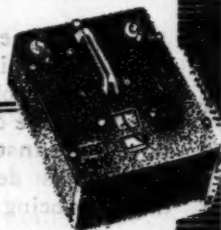


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OCTOBER 1947

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## INDUSTRIAL RESEARCH ASSOCIATIONS

THE indispensability of uninterrupted basic and applied research in every branch of industry has made Industrial Research Associations a unique and progressive feature in the industrial economy of Great Britain. The work of the Associations consists of the application of scientific knowledge to the processes operated with a view to establishing the fundamental causes of their success and to devising improved methods of production. An additional function of the Association is the sifting of the technical and scientific literature published and the dissemination of the relevant material to industrialists. Unlike in America where large-scale manufacturers and combines, like the Duponts and the General Electrics and the Mercks, have their own well-equipped laboratories, in Britain the Research Association seeks to achieve similar progress through research and application of science by means of co-operative effort. The origin, organisation, function and benefits accruing from the Research Associations were explained by Sir Edward Appleton in a speech delivered by him before the British industrialists.

"I am convinced," said Sir Edward, "that the most valuable support that can be given

to industry in meeting its particular needs for scientific knowledge, both for immediate application and for its long-term requirements, lies in the encouragement of co-operative action through the Research Associations. Remember that although Government through the Department of Scientific and Industrial Research contributes generously to the Research Associations, they are mainly financed by their member-firms and are self-governing organizations. They ought, therefore, to be well fitted for knowing the problems facing their industries and for carrying out the type of work most likely to be fruitful. If they fail in this the fault lies with their members and not with Government.

"Apart from the research they carry out, the Research Associations form centres of information and advice to their members for dealing with their day-to-day difficulties. This, together with the rights of members to propose items for investigation, to have the use of patents taken out, to submit problems for solution and to consult the Associations whenever they wish, has convinced us in the Department of Scientific and Industrial Research that the Research Associations' scheme provides the best single method



of bringing research and scientific knowledge within the reach of smaller firms.

"With the 31 Research Associations already formed, and with the others in course of formation, the main industries of the country such as textiles, metals, rubber, paint and pottery and so on are well covered, together with a number of the processing industries such as welding, packaging and production engineering.

"Cases arise of course, for example, in general engineering, where a firm's needs are not covered by a single Research Association and where it is necessary for it to join several. This would certainly be a difficulty, if the cost of joining a Research Association were not so low. A medium-sized or small firm can, however, join a number of Research Associations for a sum less than the salary of a single young scientific worker; and for this small expenditure the results of research costing many tens of thousands a year becomes available to the firm. Money should not, therefore, be a deterrent.

#### COMMERCIAL COMPETITION AND CO-OPERATIVE RESEARCH

"Many branches—the engineering industry for instance—are keenly competitive. How then do they stand in relation to co-operative research? I can quite understand the anxiety of these competitive industries that the products of the skill of their designers and engineers should remain the closest secret until full production has been achieved. That kind of competition often provides a real incentive to progress; but for the life of me I cannot see that there is any benefit whatever in each individual manufacturing concern itself, attempting to carry out the basic research which must form the stock of scientific knowledge upon which the whole industry must depend for its progress. In my opinion much of that kind of work can be much better done co-operatively.

"A brief glance at some of the items of the programmes of the Research Associations will illustrate what I mean. The Motor Research Association, for instance, is carrying out work, using the most up-to-date physical equipment, on the filtration of lubricating oils and its effect upon wear. It is studying the performance of bearings and bearing materials and the durability of gears. The Internal Combustion Engine is investigating similar problems in its field, and in the course of its work many different materials are carefully studied. This Research Association is also carefully investi-

gating several German engines of novel design to see what can be learnt of value to our industry. The Production Engineering Research Associations are carrying out fundamental work on the processes of drilling, turning and milling, on surface finish, on the performance of lathe tools and on methods of testing various types of machine tools. Work such as this, which is fundamental to the whole of industry, must be carried out well. It seems to me that it can be done most economically and efficiently in co-operative laboratories."

This account of the Research Associations by Sir Edward Appleton can easily serve as an example that could be copied in this country with benefit. The conditions prevailing in our industrial system are, to a very great degree, similar to those of Britain. There are in India, for instance, numerous small concerns, who, while anxious to encourage research in their respective fields, lack the wherewithal to maintain even a modest laboratory. These firms could join together to form Research Associations which are sure to step up their progress and, therefore, the pace of industrialisation of the country. The All-India Manufacturers' Organisation is at present best suited to sponsor such a move among the major, well-established industries in India. The Silk Research Association, for instance, will include mulberry growers, cocoon makers, silk reelers, throwers, weavers, spun and waste-silk manufacturers, dyers and silk machinery makers. Similarly cotton, wool, jute, metals, rubber, sugar, oil seeds and other interests will derive immense benefit by becoming actively research-minded. In their attempts to help themselves the Council of Scientific and Industrial Research will, needless to say, be only too eager to help them both with finance and their valuable advice and experience in the various branches of industry. It is time that the planners and executors of the vast schemes of industrialisation of the country recognised that, with the logarithmic rate of scientific and technical progress all over the world, it is a huge folly to establish any large-scale industry without the backing of an efficient machinery of research that would help discover new uses for and adopt the latest advances in the exploitation of our natural resources. We trust the enlightened industrialists of the land will not fail to come forward with practical proposals to incorporate research activity as an organic part of the industrial plan that is being contemplated for India.



## OBITUARY

Prof. MAX PLANCK

THE death of Prof. Max Planck at Göttingen on Saturday, the 4th October, removes from the scientific world a unique genius whose labours laid the foundation of modern physics. Although at the time of his death Prof. Planck was more full of years and honours than the common run of humanity, a sense of regret still abides with us that we can no longer hope to hear any more words of wisdom from his lips. The following has been written with a sense of duty to the great departed that every student of science owes—a duty to remember with reverence the great heritage of knowledge left behind by a master mind.

The workings of a unique intelligence are as inscrutable as the ways of Providence. When we contemplate how the law of distribution of energy in the spectrum of a black body (seen by Lord Kelvin as a small cloud no bigger than a man's fist arising on the fair horizon of classical physics) has grown, not into an obscuring blackness covering the world, but into a fair-land full of beauty and promise, we are struck with wonder at the shortness of time in which this has come to pass. But our wonder grows into amazement when we try to remember how all this has been made possible by the work of a genius who found a path which no one else could see and who trod it with faith and firmness till the land of promise was revealed. For, the basic idea of the quantum theory was not only revolutionary but it was attained by a circuitous path. The same blaze of intuition which led Einstein to see in the Michelson-Morley experiment a challenge to our usual conception of absolute time, led Planck inevitably to see in the law of black body radiation the death blow to the usual conception of the infinite divisibility of energy. Both the subtlety and the certainty of these two intuitions cannot be matched in the history of physics: they are unique examples to ponder over with humility and wonder.

That Planck's father was a legal luminary, being Professor of Constitutional Law at Kiel and Göttingen and joint author of the Prussian Civil Code may or may not be significant, but that Planck's teachers were such men as Helmholtz, Kirchhoff and Weirstrass, is certainly of importance for the flowering of his genius. Born at Kiel on the 23rd of April 1858, Planck studied at Munich and Berlin and obtained his doctorate with honours in 1879. His thesis on the Second Law of Thermodynamics, and his studies were certainly influenced by the discoveries and teaching of Kirchhoff who had shown that the radiation from a black body was independent of its internal constitution. In 1880 Planck became a tutor (*Privatdozent*) at Munich, and five years later he was made a Professor of Physics at Kiel. In 1889 Kirchhoff died and his place was taken by Planck as Extraordinary Professor and later in 1892 as full Professor in the University of Berlin. Here he remained for the rest of his teaching career, refusing in 1907 an invitation to succeed Boltzmann as Professor of Physics at Vienna. In

1912 he was made permanent Secretary of the Prussian Academy of Sciences to which he had been previously elected in 1894. In 1913-14 he was Rector of Berlin University, and in 1918 he was awarded the Nobel Prize for Physics. He became an Emeritus Professor in 1926 when Schrödinger succeeded him at Berlin. In the same year he was elected a Foreign Member of the Royal Society and received the Copley Medal in 1929. He was elected in 1930 President of the Kaiser Wilhelm Gesellschaft, but resigned from this office in 1938 in consequence of his political views which were anti-Nazi.

Prof. Planck had his tribulations no less than ordinary men. He lost a promising son in the first World War, and two of his married daughters died prematurely. His first wife, Marie Merck, whom he married in 1887, died after giving birth to two sons and two daughters. In 1911 he married his second wife, Margaret von Hösslin, and became the father of another son. As against some of his sorrows, he saw one of his sons become a high official in the von Papen Government. But if we look at his portrait, we see a benevolent countenance saddened by life's trials, but with still a twinkle lurking in the good-humoured eyes. A great man unspoil by success and full of faith in the future—that is how his likeness strikes us.

The great theory associated with his name—the quantum theory—arose logically from his early researches in Thermodynamics, but the logic is too deep for ordinary minds to have developed the theory. Whereas Einstein's theory of the photoelectric effect seems to make the quantum idea obvious and inevitable, the reasoning which led Planck to enunciate his theory to a startled audience is recondite and remote. Experimenters like Zummer and Pringshiem, Rubens and Kurlbaum had studied the energy associated with the various radiations emitted by a black body; and two great theorists, Wien and Rayleigh, had propounded two theories leading to different formulas, one of which agreed with experimental results in the region of short wavelengths, while the other represented the long wavelength region correctly, but neither formula could represent the whole range. It seems as if one could combine the two formulas in some way so as to describe the whole of the experimental results, but the correct modification found by Planck is not at all obvious. Planck was studying a rather obscure quantity which he encountered when applying Boltzman's ideas about entropy to the field of radiation, and he calculated this quantity from the formulas of Wien and Rayleigh. He then combined the two expressions so obtained for this elusive quantity and, working back, arrived at his famous Law of Radiation which was entirely in accord with experiment throughout the range of wavelengths studied. This in itself was an achievement, but Planck capped it by developing a theory to derive his formula, and

here he enunciated the fundamentally new doctrine that energy is emitted in discrete amounts called quanta. He also showed that the quantum is proportional to the frequency, the constant of proportionality being the remarkable quantum of action,  $h$ , since famous as Planck's constant. The successive researches of Einstein (Theory of the photoelectric effect, 1905), Bohr (Theory of the hydrogen spectrum, 1913), Compton (1922), Raman (1928), Heisenberg (The Uncertainty Principle, 1927), have only proved how this constant pervades the whole of atomic physics. His part in these later researches was more that of the master rejoicing in the adventures of younger minds, constantly counselling them not to go astray, rather than that of active participation. But when some exaggerated speculations of a philosophical character were based on the uncertainty principle, Planck asserted his individual opinion and, together with Einstein, supported the principle of Causality. As a teacher he is well remembered for his text-books, particularly those on Heat and Thermodynamics, which have been translated into various languages.

The minute attention to detail exhibited in the enunciation of his radiation formula and the happy faculty of making a grand generalization shown in the theory developed to explain the formula were characteristic of his spirit. The presence of artistic ability thus indirectly exhibited was even more evident because of

his musical talent, a characteristic common to many other great scientists including Einstein. A kind of religious spirit with which scientific investigations were carried out also contributed to the feeling of respect which he inspired in his scientific colleagues. In fact Prof. Planck himself has unconsciously revealed the essence of his spirit in some remarks he made about Sommerfeld on the occasion of the latter's seventieth birthday. We shall, therefore, close this expression of homage to a great soul by giving a translation of his sentiments regarding another great colleague. This is what he said:

"But a careful observer cannot fail to notice that in Sommerfeld's genius there is, besides a dispassionate feeling for mathematical correctness and physical reality, another motive which has its origin in a remoter region and has an aesthetic basis and which is encountered in fertile geniuses of all ages from Pythagoras to Bohr: it is the incentive due to that mysterious harmony and completeness of the picture, which the ever forward-groping fancy of the investigator discloses when he tries to fit his thought to the data furnished by Nature. Those laws which, like those of the anomalous Zeeman Effect, have not yet been completely explained are essentially the ones calculated to incite such flights of genius."

T. S. SUBBARAYA.

## FUTURE OF INDIAN SILK INDUSTRY

THE Silk Panel appointed by the Government of India holds the view that consolidation rather than expansion is the immediate need of the silk industry in India. It has recommended a five-year programme of stabilisation of the silk industry in India preliminary to a phase of expansion during the next two quinquennia.

Demand for silk generally and for filature silk especially being high in war time, there was then a considerable step-up in production under Government encouragement. Thus between 1939-40 and 1945-46 the number of filature basins rose from 1,291 to 4,639, and the area of mulberry cultivation rose from 30,000 to 78,000 acres in Mysore, from 5,720 to 18,026 acres in Madras and from 8,983 to 15,516 acres in Bengal.

But the Panel warns that if the industry thus developed by State assistance as part of war efforts is now left unsupported, it may collapse, and with it an important source of India's war strength.

Incidentally, the Panel has made a separate recommendation that Japanese silk entering India by way of reparations should not be allowed to undersell Indian silk.

The Panel has recommended consolidation and improvement of the present position of the industry along a number of lines. For the improvement of mulberry cultivation, it recommends the five-year sericultural programme adopted by the Government of Madras to other silk-producing regions, viz., Kashmir, Mysore,

Bengal, Bihar, Bombay and C.P. While pointing out the need for effective State control to ensure adequate supply of disease-free seeds, it foresees the need for 300 fully-equipped grainages, costing Rs. 20,000 each, to meet the total requirement of India, which will be about 12 crores of layings. To control silk-worm diseases, the Panel adds, there should be in each silk-producing region a special enactment as in Mysore.

### ULTIMATE TARGET OF PRODUCTION

In order to have the charkhas replaced by the filatures, a change on which rests the hope of the silk industry in India, the Panel recommends the setting up of co-operative societies on lines suited to local circumstances. It also pleads for authoritative establishment of definite standards conforming to accepted international grading. It emphasises co-operation among the various silk-producing areas in the country and recommends the establishment of a Central Silk Board representing all silk interests.

In the next five years, says the Panel, 49,868 acres more or 1,62,500 acres in all will be under mulberry cultivation and this will increase to a total area of not more than 1,87,500 acres (excluding Kashmir) in the 3rd quinquennium. Including the increase of 50 per cent. in the production of silk in Kashmir, the Panel does not foresee all-India production to be more than 4 million lbs. per annum at the end of 15 years, the annual consumption being estimated at 15 million lbs.

## THE INDIAN BREWERY TRADE

K. S. RANGAPPA

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MOST Indians are, by custom and practice, teetotallers; and alcohol consumption is confined to a small section of the working classes, these spirits being largely derived from the palm trees (*Phoenix sylvestris*, *Cocos nucifera*, *Nipa fruticans* and *Borassus flabelliformis*). The National Government, now in power, with its natural solicitude for the welfare of the masses, is taking steps to eradicate this evil. It won't be much of a prophesy if we state that India will succeed in this reform where other countries have failed. At the present speed of progress it will hardly be a few years before the whole country is dry. But the uprooting of an age-long, deep-rooted social evil naturally causes, in the initial stages, great dislocation and upheavals in the social strata.

Toddy brewing is quite an ancient industry in India. This, like all ancient professions in the country, has created its own hereditary class of toddy-tappers and brewers, uninterested in any other profession. The sudden and total extinction of the trade has, therefore, caused great hardship to all who live by this trade. And the sponsors of the reform are now hard put to it to find an acceptable alternative profession for these men. Many of these difficulties could have been avoided if scientists had been taken into the confidence of statesmen and legislators. Even now it is to be hoped that rational steps will be taken in rehabilitating people unemployed as a result of this salutary reform and that the raw material of this industry will be utilised for productive purposes.

An impression appears to prevail among the public that the palms from which toddy is tapped is good for little else. This is not necessarily so. The sap of the tree, from which toddy is fermented, contains a high percentage of sugar<sup>1</sup> (10-16 per cent. depending on the species) and vitamins. It stands to reason that the sweet fluid could be commercially exploited as a source material, even as cane juice, for "palm sugar". The juice of the nipa palm is almost equal in saccharine richness to cane juice, with the advantage that it is much cleaner and contains no colouring matter nor chlorophyll; the vegetable matter being easily precipitated, gives a liquor as clear as spring water. With the successful elimination of the rather high saline content of the juice it must be possible to produce sugar from this source on a competitive basis. Of date-palm sugar we know that the yield per acre is definitely higher than of

cane, and it costs so little to grow these palms which have an average yielding life of 30 years.<sup>1</sup> In fact, manufacture of "palm jaggery" (Gur) containing about 60 per cent. of sucrose and 15 percent. of fructose<sup>2</sup> is a cottage industry in some parts of the country. Annually, 100,000 tons of the jaggery are produced in Bengal, and about 40,000 tons in Madras.<sup>2</sup> Some factories in South India have been refining palm-jaggery for years on a commercial scale. Now it is but a step to turn over all the sweet-palm sap that was being fermented into toddy for the manufacture of refined sugar. And the sugar from this source is likely to make no mean contribution to the country's supply in this commodity. For, each tree yields about 37 lb. of sugar per year; and assuming 350 trees per acre, this would mean 3.6 long tons of sugar, which is not much less than the production (about 4 tons per acre) from sugarcane.<sup>2</sup> The existing area of about 200,000 acres covered by palm<sup>3</sup> has, therefore, a potential capacity of yielding 600,000 tons of sugar, i.e., a valuable 10 per cent. extra production of the nation's sugar supply.

It must also be possible for technical processes to be developed for producing power alcohol from the palm juice or jaggery or the residue (corresponding to cane molasses) from refined palm sugar. As an indispensable part of the defence needs of the country—we have no natural resources of oil or gas—it is the essence of statesmanship to cultivate all sources of power even if it cannot quite compete with imported oil in normal times. Palm juice can also provide the basic material for the production of food yeast and essential vitamins both of which could well supplement the present meagre supply. The unfermented sap is claimed, by the indigenous systems of medicine, to be a cure and health-giving tonic for certain diseases. And it is known that it is a good diuretic. Pharmacology might evaluate its precise medicinal worth and press it into service if found useful. Well planned and well exploited, it should be possible not only to face successfully the present crisis of unemployment and dislocation, but establish new and productive industries on the gravestone of the Giant Evil that was Drink.

1. Heriot, "Manufacture of Sugar," 1920, p. 30, Longmans Green & Co., Lond. 2. Gandhi, M. P., The Indian Sugar Industry (Annual), 1939, p. 189. 3. The Indian Year Book, 1947, p. 328 (Times of India Press).

## SUPERSONIC VIBRATIONS—A NEW DETERGENT

The washing of materials with high-frequency vibrations instead of with soap and boiling water has been accomplished by the British Launderers' Association Laboratories. Most of the dirt molecules adhering to fabrics are negatively charged; and generally speaking, electrical forces can be held responsible for this adhesion. Supersonic vibrations applied via

a quartz reproducer to a soiled fabric immersed in water or other medium shakes out the dirt, the vibrations being strong enough to overcome the electric adhesion of the dirt molecules. Experimental test-pieces of soiled fabric, it is said, have been vibrated clean within ten minutes. The apparatus, however, is still in the experimental stage.



# VARIATIONS IN THE SEASONAL COMPOSITION OF THE PHYTOPLANKTON OF BOMBAY HARBOUR

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THE plankton of Bombay Harbour has been studied by Bal and Pradhan,<sup>1</sup> but their work deals mainly with the zooplankton. This investigation is concerned with the phytoplankton of their collections, which were made regularly twice a week from July 1944 till August 1946. A rough estimate of the number of forms was obtained by the method of Lebour. A fixed quantity of water was centrifuged, and symbols such as cc, c, +, r, and rr, were given to species according as 30 or more, 20 to 29, 10 to 19, 2 to 5 or 1 were present in the sample. This method, though not very accurate, gives a fair idea of the seasonal abundance of the phytoplankton.

The phytoplankton consisted chiefly of Diatoms and Peridinians. In all 54 genera and 126 species of Diatoms and 13 genera and 34 species of Peridinians were recorded. Subrahmanyam<sup>2</sup> has recorded 171 forms of Diatoms from the Madras coast, while in previous studies the maximum number recorded has been 41 species of Diatoms and about 20 species of Peridinians from the Trivandrum coast by Menon.<sup>3</sup> The number of Diatoms recorded in Bombay is not as many as in Madras, the reason probably being that the area of collection was restricted in this investigation to Bombay Harbour alone. The number of Peridinians observed here is considerably more than that of previous workers.

The genera which were seen in fairly large numbers in most of the collections (except those of the monsoon) were *Chaetoceros* (24 species), *Coscinodiscus* (13 species), *Biddulphia* (7 species) and *Bacteriastrum* (6 species). Occasionally swarms of *Ditylum* and *Corethron* occurred in August and November respectively; but these were more of the nature of ephemerals, as they also disappeared suddenly. Of the pennate diatoms *Pleurosigma* (7 species) and *Nitzschia* (5 species) were common.

From the beginning till the middle of the rainy season, i.e., from June to August, the plankton collections were very poor. A number of filaments of *Trichodesmium* were observed at this time. Due to the winds, a considerable disturbance was created in the sea and the water was mixed over a great depth. Towards the beginning of September, there was a sudden increase in the number of Diatoms and by the end of September, fairly good collections were obtained. From September onwards, Diatoms steadily increased in number, till the maximum was reached in the month of January and beginning of February. After this, their number decreased steadily till May. In May, however, a number of pennate Diatoms, probably mud-inhabiting forms brought up through disturbance of the waters by the strong winds of the south-west monsoon, occurred. Few Peridinians were seen during the monsoon and appreciable numbers were only recorded in the middle of October. Their maximum, however, was attained rapidly in the third week of December. They could never vie with the

Diatoms in quantity, and even during their periods of maximum abundance, the Diatoms far outnumbered them. They seemed to favour the early part of the cold season, while the Diatoms seemed to prefer the latter half of the same season.

The following summary of the occurrence and seasonal variations of some of the more important genera will afford a comprehensive idea of the occurrence of the phytoplankton as a whole:—

*Skeletonema*: It occurred in September, rapidly increased in number, and was fairly common at the end of September and October. Thereafter its numbers decreased, and though seen till February, it was never common after October.

*Thalassiosira*: Towards the end of January 1945, *Thalassiosira subtilis* (Ostenfeld) Gran. never observed before this—occurred in small numbers. In the first week of February, heaps of these delicate forms embedded in mucilage were seen. In the latter half of February, the number decreased, and by March, it had disappeared. In the following year, 1946, it occurred occasionally and never in large numbers.

*Coscinodiscus*: During the monsoons, this genus was represented by a few specimens. In September, it gradually increased in numbers and by the end of October, it was common. The best represented species were *C. concinnus* W. Smith, *C. radiatus* Ehr., *C. lineatus* Ehr., and *C. centralis* Ehr. By the middle of November, *C. concinnus* W. Smith was abundant. It decreased slightly in number subsequently, but in January it had a second rise. *C. centralis* Ehr. showed a steady increase from September till it reached its maximum in March. *C. radiatus* Ehr. and *C. lineatus* Ehr. were seen in appreciable numbers throughout the same period. After March, a reduction in numbers occurred which was maintained in April and May. By June it had almost completely disappeared.

*Chaetoceros*: It also occurred in September and most species had increased considerably by October. In November some of the species were seen in lesser numbers, but a second maximum occurred either in January or February for these. The commonest forms were *Ch. peruvianus* Brightwell (max. third week of December), *Ch. Lorentzianus* Grunow (first max. end of October, second max. early February), *Ch. diversus* Cleve (first max. middle October, second max. early January), *Ch. affinis* Lauder (max. early February), and *Ch. didymus* Ehr. (max. end of January). From May to August it was rare.

*Rhizosolenia*: It was seen from September to May. Its maximum occurred towards the end of December and was maintained till the end of February. The common species were *R. imbricata* Brightwell, *R. setigera* Brightwell and *R. hebetata* Gran., all reaching their maxima between January and February.

**Biddulphia**: Of this genus, the commonest species was *B. sinensis* Graville. It occurred towards the end of August and was common in September, when the other species of this genus were poorly represented. It reached its maximum in January, but was seen right till April in lesser numbers. *B. mobilensis* Bailey had its maximum at the end of December. The other species of *Biddulphia* occurred occasionally in varying numbers.

**Pleurosigma**: It was common from November to May, reaching its maximum towards the end of April. The commonest species was *P. normanii* Ralfs.

Of the other Diatoms, *Bacteriastrum hyalinum* Lauder, *Planktoniella sol* (Wallich) Schütt and *Nitzschia seriata* Cleve were never absent from any collection except during the rains. *Melosira* though rare throughout the year, was seen in appreciable numbers in April.

Among the Peridinians, the common genera were *Dinophysis* (3 species), *Ceratium* (9 species) and *Peridinium* (10 species). All appeared from November till March. The commonest species of *Dinophysis* was *D. miles* Cleve (max. early Dec.). *Ceratium* was best represented by *C. fusus* Ehr. and *C. furca* Ehr. Both had their maxima towards the end of December. The commonest species of *Peridinium* were *P. depressum* Bailey (max. early December) and *P. oceanum* Vanh. (max. end of December). *Ornithocercus* occurred in December, but not in large amount.

A general comparison only can be made here with the observation of workers in other parts

of India. In Bombay the period of phytoplankton scarcity is from May till August after which there is an increase till the maximum is reached in January and February. In Madras,<sup>4</sup> the maximum is in April and May followed by a fall in numbers. After a small rise in July, there is almost complete absence of the Diatoms from the plankton till the middle of September, when there begins a gradual increase. In Trivandrum,<sup>3</sup> the Diatom maximum occurs in April and May as in Madras. This maximum as it coincides with the onset of the south-west monsoon is attributed to the river floods bringing in large quantities of organic and inorganic food materials into the sea. In Bombay, as there are no rivers, there is no phenomenal increase in the Diatom population in May. In fact, there is almost total absence of form. This can be attributed to the disturbed and unsettled condition of the water brought about by the thunderstorms and fairly heavy rains that accompany the south-west monsoon, or it may be due to the exhaustion of the essential plant foods.

This investigation was carried out at the Royal Institute of Science, Bombay. My thanks are due to Dr. D. V. Bal for placing the material at my disposal and for his valuable suggestions, as also to Mr. L. V. Pradhan for arranging to obtain the samples.

1. Bal, D. V., and Pradhan, L. V., *Curr. Sci.*, 1945, 14, 211. 2. Subrahmanyam, R., *Proc. Ind. Acad.*, 1946, 24, 3. Menon, M. A. S., *Ibid.*, 1945, 22, 4. Sankara Menon, K., *Rec. Ind. Museum*, 1931, 33.

## HEARTBEATS

JOHN ERIC HILL

THE heart of a warm-blooded vertebrate is an extraordinary, hard-working pump, functioning at a level of activity unequalled by any mechanical device. The wonder is that any heart beats as long as it does. The average person's heart beats about 72 times a minute, 4,300 times an hour, and more than 2,500,000,000 times in a life-time of 70 years. While you are reading this, each minute the heart pumps about 10 quarts of blood, doing work at a rate of about 200 foot-pounds per minute. If you are in good physical condition and run quickly up a flight of stairs, your heart may work three times as hard.

The pulse rate varies greatly in different mammals. When a mouse is resting, its pulse is about 700, ten times as fast as man's. A cat's heart beats about 120 per minute, a dog's 85 to 125, while a horse's or cow's heart beats only 35 to 45 times a minute. The heart beats more rapidly in a young mammal than in an older one. Even in adults of the same species a small individual has a faster heart-beat than a large individual. A toy terrier, for instance, may have a pulse more than half again as fast as a St. Bernard's. From this, the conclusion may be drawn that the heart rate in mammals generally decreases with an increase in size.

This is because a small mammal lives at a high speed. A mouse's metabolic rate, measured by its consumption of oxygen per unit of weight is about 20 times that of a man. A small dog may need, for its size, twice as much food as a large dog. The rapid loss of heat by radiation from a small body requires the "fires" of life to blaze high continually.

Some of the extra circulation necessitated by these factors may be provided, in part, by relatively large hearts. The normal human heart is about one two-hundredth of the weight of the body. The heart of a small bat may be relatively three times as large. Mammals that lead a very active life, as diggers or swift runners, may have disproportionately large hearts. That of a deer, a badger, a wolf, or a weasel may be one-hundredth of its weight. In contrast, hearts of sedentary domestic animals or secretive rodents are only about one-half or one-third as large. A jack rabbit's heart is almost three times as big as that of a domestic rabbit weighing the same amount; and when it is resting, it pumps about the same amount of blood but at a rate only one-third as fast. When the jack rabbit must run for its life, its heart can speed up and pump four times as much as while resting.

There is a relation between the speed of the heart-beat and the life-span of an animal. The mouse with a pulse rate of 700, lives only about two years; its heart performs a total of some 700,000,000 beats. A cat or dog lives through about the same number of heart-beats, and an elephant may live through 1,000,000,000. Some of our smaller bats, with the fastest heart-beat of any mammal, live eight years or more. If they hibernate, as they do in the cold north, the heart-beat drops from 700 or more to only 30 a minute. Allowing for this decrease in activity, such bats have a heart-life of some 2,000,000,000 beats.

—Courtesy, "Natural History".



## NEW STATISTICAL METHOD OF PREDICTING SUNSPOTS

THE prediction of solar activity, which greatly affects radio communication and is evidenced by spots on the sun, has been advanced through the application of a new statistical method, by A. G. McNish and Virginia Lincoln of the National Bureau of Standards, Washington. The new technique, depending on available sunspot data for a number of previous 11-year cycles, has a sounder scientific basis than former methods of prediction. Moreover, it is expected to be applicable to a wide variety of cyclical phenomena, such as long-term weather variations and climatic changes (cf. Ramamurthi, *Curr. Sci.*, 1947, p. 213).

Long-distance radio transmission is made possible by the ionosphere, a series of layers in the atmosphere 50 to 250 miles above the earth. Radio waves sent out near the earth's surface travel in straight lines until they reach the ionosphere and are reflected back to the earth, just as light striking a mirror is reflected. This reflection of radio waves is due to the fact that the ionosphere is made electrically conducting as a result of the ionization of gas molecules in its layers by ultraviolet light from the sun.

With the discovery of the close relationships existing between radio propagation and sunspot activity, the prediction of sunspot numbers assumed great practical importance. In the development of a satisfactory sunspot-prediction formula at the National Bureau of Standards, it was assumed that (1) in a time series exhibiting cyclical tendencies, a first approximation to a future value is the mean of all past values for the same stage of the cycle, and (2) this approximation can be improved by adding to the mean a correction proportional to the departure of earlier values of the same cycle from their respective means. The second assumption is justified by the observed tendency in sunspot numbers for annual deviations from the mean to have the same sign and similar magnitudes in consecutive years.

The prediction formula then becomes

$$R_n' = R_n + k_{n-1} \Delta R_{n-1} + k_{n-2} \Delta R_{n-2} \dots$$

where  $R_n'$  is the predicted value in a particular cycle,  $R_n$  the mean of all corresponding values in preceding cycles,  $\Delta R_{n-1}$  the deviation of the particular  $R_{n-1}$  for this cycle from the mean of all  $R_{n-1}$ 's from previous cycles, and the  $k$ 's are proportionality constants.

The least-squares criterion that the sum of the squared deviations from the mean be a

minimum was used in evaluating the proportionality constants. Upon comparison of observed values with those predicted by this method, it was apparent that the best prediction is usually obtained by setting all of the  $k$ 's except in one for the previous year equal to zero, and this procedure is followed in most cases.

The sunspot number is obtained by counting the number of sunspot groups, multiplying by ten, and adding to the result the number of individual sunspots in each group. This statistical convention was adopted at the Zürich Observatory in the middle of the nineteenth century, and since that time has been standard all over the world. The highest monthly average sunspot number in over 100 years, and one of the highest of all time, occurred during May 1947.

The importance of sunspot prediction is shown by comparison of radio transmission in 1944 with that in 1947. In 1944 sunspots were at a minimum, the ionosphere was weakly ionized, and the higher frequency radio waves passed out into space without reflection. During the year, transmission across the North Atlantic was rarely possible for frequencies above 20 megacycles. For 1947, on the other hand, the extremely high annual sunspot number of 126 is predicted, and already transmissions using frequencies above 50 megacycles have been logged over this path.

Daily "soundings" of the ionosphere are taken all over the world by an international network of 58 ionosphere stations, 14 of which are operated or supported by the Bureau. These daily soundings measure the critical frequency (the limiting frequency for reflections back to the earth), absorption of radio energy (an indication of the power required to transmit a given frequency over a particular distance), and the heights of the various layers (determined through the use of radar-like echo equipment). The sunspot predictions are correlated with this information to provide the working data used at the Bureau in predicting radio propagation characteristics.

Groups now using the service include airline companies, steamship lines and the merchant marine, television and radio schools, American and foreign universities, radio and telegraph companies, manufacturers of communication equipment, research laboratories and geophysical exploration organizations.

## ATOMIC PILE PRODUCTS TO REPLACE SURGERY

MEDICAL physicists, in dozens of the United States laboratories, are working to-day on what promises to develop into the first evolution of therapy and surgery through atomic fission. The process that fascinates the pioneers of nuclear medicine is the so-called "selective localisation" of radioactive elements in the human body. Its perfection, in simple terms, would amount to the destruction of diseased body tissue, not by the surgeon's knife, but by

the radioactivity of chemicals taken internally. The key to the evolution lies in the radio-isotopes, those radioactive twins of normal elements which are produced in the atom-smashing cyclotron or in the atomic pile.

At the University of California in Berkeley, one of the foremost centres of medical physics in the United States, Dr. John L. Lawrence has been working with radioactive isotopes for more than twelve years.

In his laboratory on the Berkeley campus he described the present status of medical physics and what is emerging as the next step in therapy.

Dr. Lawrence explained, "Here at Berkeley we have produced isotopes in the atom-smashing cyclotron since 1934. The atomic pile, less versatile than the cyclotron, has but one great advantage—mass production of isotopes. That means that such isotopes as carbon 14 are now widely available. It means that cyclotrons can now concentrate on producing those valuable isotopes which are too short-lived to be shipped; they would decay during shipment. We now get carbon 14 delivered; that means that in our cyclotron we can produce more carbon 11, another isotope so short-lived that it loses half its radioactivity within 21 minutes. Yet, by rapid experimental work we were able to use it, and have come to astonishing results.

"With the methods now available, that is to say mainly cyclotron and pile, radioactive forms of nearly all the 92 or more elements in the periodic table can be produced artificially. With carbon 14 alone, a dozen new laboratories could be kept busy for the next thirty years, so vast is the scope of its peace-time application.

#### Beginning of New Era in Medical Knowledge

"We have seen only the beginning of a new era in man's medical knowledge. In the Berkeley laboratories we have used for biological and medical research some 40 isotopes so far, among them carbon 11 (with a half-life of 21 minutes); hydrogen (with a half-life of 31 years); two isotopes of sodium, and one each of phosphorus, sulfur, calcium, iron and iodine. Considering that in the human body there are only some 20 elements of major importance, the scope of research and therapy that might evolve from some 100 radioactive substances become apparently limitless. And medicine may look forward to a revision of accepted theories, to new knowledge, and to new riddles.

#### Therapeutic Application of Radioactive Isotopes

"In our latest tracer experiment we found that certain radioactive isotopes along with their inactive sister-elements show a definite tendency to deposit themselves in certain areas of the body. It is this tendency which we call 'selective localization' and which promises to develop into a broad new field of therapeutic application of radioactive isotopes. For example, radioactive carbon-monoxide, compounded with the short-lived isotope carbon 11, was gobbled up by the liver and held there for a while, before being released. We know that radioactive iodine 131 tends to settle in the thyroid gland. The concentration of iodine atoms in the gland may be several hundred times that in any other part of the body. With larger than tracer doses it was possible in rabbits to remove their thyroid glands by slow selective radiation which destroyed the glands without damage to other tissue. Other isotopes concentrate in the bone marrow, still others in the spleen.

"What we are now trying to do, after these initial observations and the successful treatment of goiter by internal radiation, is this: we try to find compounds which would localize in a specific area of the body. If we find such a compound for each vital organ, we can introduce it in the body and hit the abnormal area without damage to other organs.

"Many diseases, particularly in the cancerous group, require radical removal of the diseased tissue. Selective radioactive compounds would settle down in the affected areas, bombard the diseased tissue with radiation and destroy it, making the surgeon's work unnecessary. Ultimately, we might find a radioactive compound for each particular organ and for each particular type of cancer.

"To-day we are at the beginning of fundamental research. A stream of contributions can be expected from the mass production of radioactive isotopes which are the stepping stones to the medical methods of tomorrow."—USIS.

### GEOMAGNETIC STORMS

Some details of the geomagnetic storms recorded at the Alibag Magnetic Observatory during the quarter July to September 1947 are given in the following table in which  $t_0$ ,  $t$  represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively and  $T$  the duration of the intense phase

expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in  $\gamma$  where  $1\gamma = 10^{-8}$  gauss. The maximum  $k$ -index recorded during the storms have also been given.

Date	$t_0$	$t$	$T$	Range			$k_m$	Nature of commencement
				D	H	V		
1947	H. M.	H. M.	Hrs.	Min.	$\gamma$	$\gamma$		
July, 17-19	.. 23 18	18 14	6	8.5	298	62	8	Sudden
August, 15-17	.. 15 20	21 36	8½	10.6	264	72	7	Sudden
August 22-24	.. 14 40	14 43	4	9.0	306	87	8	Sudden
September, 3-4	.. 04 54	11 00	5	14.7	373	135	8	Sudden

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## OSCILLATION CHARACTERISTICS OF A HARTLEY OSCILLATOR

APPLETON<sup>1</sup> and Appleton, Watt and Herd<sup>2</sup> determined the oscillation characteristics by direct experiment for valve circuit. They did not try the Hartley circuits. Neither did they draw the oscillation characteristics by calculation from the static characteristic curves of the valve. In the present communication comparative study of the oscillation characteristics for the Hartley oscillator by the two methods is put forth.

2. Let  $M$  be the mutual inductance between the grid and the plate coils whose inductances are  $L$  and  $L_s$  having negligible resistances. The relation between the induced anode potential  $v_s$  and the induced grid potential  $v_g$  is given by

$$v_s = -\frac{L_s}{M} v_g \quad (1)$$

It is well known that  $M$  must be negative to produce self-excitation so that  $v_s$  and  $v_g$  are in opposite phase. The anode current  $I_a$  at any instant is a function of both the anode and grid potentials for a given filament current; and the action of a triode is usually interpreted in terms of the relation,

$$I_a = \phi(V_0 + v_s, v_g) \quad (2)$$

where  $V_0$  is the steady potential applied to the plate of the valve. The direct determination of the relation between  $I_a$  and  $v_s$  can be done when the values of  $v_g$  are made consistent with the relation (1). Then we have

$$I_a = \phi\left(V_0 + v_s, -\frac{M}{L_s} v_s\right) \quad (3)$$

as oscillation characteristic.

3. A parallel fed Hartley Oscillator circuit suitable for short-wave range 50 to 150 metres, of which the oscillation characteristics were determined is shown in Fig. 1. This is fitted

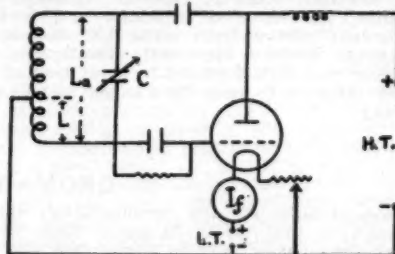


FIG. 1

with the usual pulse generating device of a fixed condenser shunted by a high resistance.

From the dimensions of the coil  $L_s$  and the position of tapping, the values of  $L_s$  and  $M$  were calculated by usual formulae and found to be 18.6 and 10.1  $\mu$ H respectively, giving the ratio

$$\frac{L_s}{M} = 1.84. \quad (4)$$

As a check the value of  $L_s$  was experimentally determined by calibrating the oscillatory circuit for wave-length  $\lambda$  and plotting a graph between  $\lambda^2$  and the corresponding capacity of the variable condenser  $C$ . This graph is evidently a straight line. The gradient of this line gave

TABLE I  
( $V_0 = 60$  volts)

$v_a$ volts	..	+10	+8	0	-10	-14	-20	-30	-35	-40	-50	-60
$I_a$ mA	..	..	1	5	13	16	20	25	26	24	14	0

TABLE II  
 $V_0 = 100$  volts

$v_a$ Volts.	..	+20	+16	+10	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
$I_a$ mA	..	..	1	3.5	12	22	30	36	39	40	37	32	22	13	0

the value of  $L_s$  as  $18.58 \mu H$ , which is in close agreement with the calculated one.

The experimental arrangement for the direct determination of oscillation characteristics is shown in Fig. 2. The fixed non-inductive

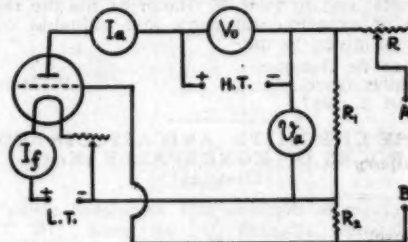


FIG. 2

resistances  $R_1$  and  $R_2$  are so chosen that

$$\frac{R_1}{R_2} = \frac{L_s}{M} = 1.84$$

A variable resistance  $R$  serves to adjust the potential  $v_a$  to any required value, which can also be made negative or positive by interchanging the connections of D.C. supply between A and B. The filament current was maintained constant at the rated value of 150 mA. A series of readings of  $I_a$  corresponding to  $v_a$  beginning from positive and ending with negative values were recorded, for

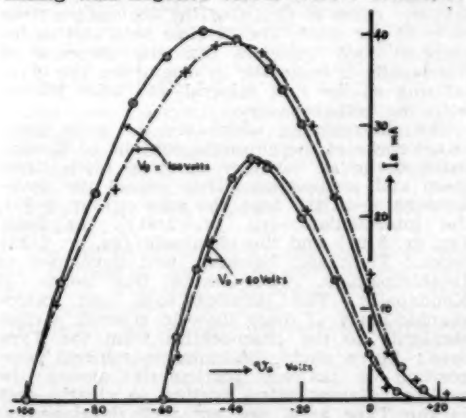


FIG. 3

two different values of  $V_0$ . These are given in the Tables I and II.

The two oscillation characteristics are graphically shown in Fig. 3 by full lines.

4. Appleton<sup>1</sup> has mentioned that the oscillation characteristics of a circuit could be drawn from the  $I_a$ ,  $v_a$  curves of the valve but this process involves laborious calculations. The present author has used plate-potential plate-current characteristic curves for different grid bias, to effect simplification.

With this in view,  $V_a$ ,  $I_a$  static curves were determined for several values of  $V_g$  ranging between -12 volts to +60 volts. Then using relations (1) and (4) and remembering that  $V_a = V_0 + v_a$ , the values of  $I_a$  are read off from these curves corresponding to the values of  $V_a$ . Calculations are made for two oscillation characteristics corresponding to  $V_0$  equal to 60 and 100 volts. These are given in Table III.

TABLE III

$v_g$ Volts	$v_a$ Volts	$V_0 = 60$ Volts		$V_0 = 100$ Volts	
		$V_a$ Volts	$I_a$ mA	$V_a$ Volts	$I_a$ mA
-12	22.1	82.1	..	122.1	0.5
-8	14.7	74.7	0.5	114.7	1.5
-3	5.5	65.5	1.0	105.5	5.0
0	0	60.0	6.0	100.0	13.5
10	-18.4	41.6	20.5	81.6	29.5
18	-33.1	26.9	25.5	60.9	37.5
25	-46.0	14.0	17.0	54.0	38.5
30	-55.2	4.8	4.5	44.8	35.5
40	-73.6	..	..	26.4	22.5
50	-92.0	..	..	8.0	10.0

The two calculated oscillation characteristics are shown by broken lines in Fig. 3.

5. Although there is a slight difference between the calculated and the observed values of  $I_a$ , yet the agreement between the two may be deemed as fairly good considering the uncertain factors like over-heating of the valve in such experiments.

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July 17, 1947.

1. Appleton, E. V., *Phil Mag.*, 1921, 42, 201. 2. Appleton, Watt and Herd, *Proc. Roy. Soc.*, 1926, 111, 672.



### TIME FACTOR IN ELECTRIC BIREFRINGENCE OF GLASS

THAT electric birefringence has a time-lag behind the instant of the application of the electric field has been well known ever since the discovery of the effect by Kerr in 1875. This time-lag has also been known to be of much greater magnitude in solids than in liquids and gases. Kerr himself estimated the lag for glass as about half a minute, within which, he observed, the substance exhibits full and maximum birefringence. While this has been found to be substantially true—at least approximately—in the densest flint glass containing the highest percentage of lead, recent experiments undertaken to determine the Kerr coefficient in a variety of glass samples have, however, revealed interesting departure from Kerr's conclusions on the point. It has been observed in all varieties of glass, except the densest flint referred to above, that although the electric birefringence and, therefore, the Kerr coefficient increases at first to a positive maximum within about a minute of the application of the field, in the intervals of the time to follow, they do not remain constant at that peak value in a steadily applied field of force. For several minutes to follow, these varieties have all exhibited a decreasing birefringence settling down to a minimum of residual positive value in cases of lead glasses, and to a minimum of reversed negative value in samples free from lead; the time required for this downward creep depending on the composition of sample under observation. The amplitude of the downward creep and of the reversal, as the case may be, has been found to be magnified by an increase in the applied field, while the time-lag of the effects in general is observed to decrease.

The effect observed on the withdrawal of the field, having almost the nature of an optical image of that observed on the application, is also highly interesting. Contrary to Kerr's observation that the electric birefringence decreases steadily to zero value within about half a minute of the withdrawal of the field (which has, of course, been confirmed with the densest flint glass containing the highest percentage of lead), it has been observed in all other varieties that the birefringence diminishes down to a reversed negative value within about a minute of the withdrawal of the field, and then tends slowly to creep up to zero value in several minutes to follow, the time required by the sample to revert to its normal condition of non-birefringence, being usually long, and also depending on the composition of the variety under examination.

The nature of the variation observed seems to suggest that the total effect observed is due to the superimposition of two component effects of opposite signs, one of which, the positive one, is to be taken as the Kerr effect as regards the negative components, it might, at the first thought, be taken as the electrostriction effect. But the effect arising out of the electrostriction may be estimated in any sample either by the experiment or from theoretical considerations. This must be very small in

comparison with electro-optical effect, for, in glass, while the coefficient of the electro-optical effect is of the order of  $10^{-9}$ , that for the strain-optical effect has the order of  $10^{-13}$ .

The negative effect in some cases, has, however, been observed to be of magnitude comparable with the positive. Further, strain-optical effect arising out of electrostriction should increase with the dielectric constant of the sample. But observations show that samples having a comparatively higher dielectric constant are characterised by a feeble negative effect. These considerations exclude the possibility of the negative effect being identified with electrostriction.

The details of the experiment undertaken along with the curves showing the variation of the Kerr constant with time will be shortly published in a paper elsewhere.

I acknowledge my indebtedness to the Indian Association for the Cultivation of Science, Calcutta, and to Prof. K. Banerjee for the facilities of experimental work and valuable suggestions given to me.

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### THE CHROMITE AND ASSOCIATED ROCKS OF KONDAPALLE (Kistna District)

THE chromite deposits and associated rocks of Kondapalle, situated in an area ( $16^{\circ} 37' : 80^{\circ} 32\frac{1}{2}'$ ), about ten miles to the N.W. of Bezawada, have been studied. The geological features of the area comprise, the Bezawada gneisses, the granitic gneisses and the charnockites, and the chromite deposits are restricted to the ultra-basic charnockites, mainly the pyroxenites (enstatite-hypersthene rock). The occurrence of the chromite is chiefly in the form of pockets or lenses, in disseminated patches and often in regular and perfect bands. No olivine has been found, and the serpentine noticed in certain places is due to the alteration of pyroxene. Chemical analyses of representative chromite ores from the area show that the value of  $\text{Cr}_2\text{O}_3$  of the ore ranges from 36 to 55 per cent. The detailed field and petrographic study indicates that the chromite of Kondapalle is magmatic in origin, the ore crystallising as the first mineral and later joining with the orthopyroxene.

The charnockites, which are the main associated rocks of the chromite deposits of Kondapalle, occur as bouldery outcrops often times steep and precipitous. They reveal the development of all the four, the acid (sp. gr. 2.80), the intermediate (sp. gr. 2.91), the basic (sp. gr. 3.01) and the ultrabasic (sp. gr. 3.25) types. They are, however, best developed at Ibrahimpatnam, three miles due south of Kondapalle. The detailed field and petrographic study of these show in general, a close similarity to the charnockites from the Type area; but a slight difference in mineral composition is noticed, particularly among the norites. Garnetiferous norites, so clearly seen in the Type area, are not well developed at Kondapalle, thereby showing that the charnoc-



Constituents	Acid charnockite			Basic charnockite			Ultrabasic charnockite		
	K. Palle	Type area	Mysore	K. Palle	Type area	Mysore	K. Palle	Type area	Mysore
SiO <sub>2</sub>	66.97	77.47	78.57	49.09	50.04	50.11	45.34	46.86	48.24
Al <sub>2</sub> O <sub>3</sub>	13.26	11.00	11.97	9.68	11.65	14.81	2.03	9.80	13.03
Fe <sub>2</sub> O <sub>3</sub>	3.61	1.04	0.84	10.48	2.63	2.00	11.09	2.28	2.28
FeO	4.90	2.02	1.16	11.42	15.76	11.38	19.28	10.35	7.20
TiO <sub>2</sub>	Trace	0.26	0.24	0.01	1.93	0.84	Trace	..	Trace
CaO	4.51	1.02	3.06	10.92	7.89	11.52	5.64	9.57	13.48
MgO	1.80	0.43	0.27	3.95	5.58	7.64	12.65	18.08	10.72
MnO	0.08	..	0.20	0.20	..	0.31	0.56	..	0.81
Na <sub>2</sub> O	1.09	2.56	3.90	3.00	3.08	2.37	0.51	..	2.88
K <sub>2</sub> O	3.92	4.14	0.52	0.90	0.89	0.16	Trace	..	0.23
S	..	..	..	0.11	..	..	2.57	..	0.15
BaO	..	..	..	..	..	..	Trace	..	..
ZrO	Trace	..	..	..	..	..	..	..	..
P <sub>2</sub> O <sub>5</sub>	..	..	0.05	..	0.20	Trace	Trace	..	0.07
H <sub>2</sub> O	0.26	0.25	0.30	0.47	0.19	0.37	0.24	0.67	0.64
Cr <sub>2</sub> O <sub>3</sub>	0.01	..	..	Trace	..	..	0.11	..	..
Total	100.41	100.49	101.08	100.20	99.69	101.01	99.96	101.33	99.73
Norms of the above									
Quartz	26.76	41.22	44.48	3.05	..	..	7.20	..	..
Orthoclase	22.80	24.46	2.78	5.56	5.00	1.11	..	..	..
Albite	16.24	24.10	33.01	25.15	26.20	20.04	4.19	..	..
Anorthite	16.12	5.00	13.90	10.29	15.27	27.52	3.34	..	..
Diopside	5.10	..	0.92	36.66	19.43	24.40	20.42	..	..
Hypersthene	7.89	3.34	1.82	3.28	20.27	15.89	42.38	..	..
Olivine	..	..	..	..	5.63	6.00	..	..	..
Ilmenite	..	0.61	0.46	0.15	3.65	1.52	..	..	..
Magnetite	5.34	1.62	1.16	15.08	3.71	3.02	16.01	..	..
Apatite	..	..	0.34	..	0.34	..	..	..	..
Pyrites	..	..	..	0.36	..	..	3.66	..	..

kites of Kondapalle are not uniformly subjected to such an advanced stage of metamorphism when garnet can make its appearance. Mineral transformations due to metamorphism, like the amphibolisation of pyroxene and the conversion of hypersthene to garnet with the formation of kelyphitic borders are clearly seen. Chemical analyses of the representative charnockites from Kondapalle, in comparison with those from the Type area and Mysore are given in the above table.

The field relationship of the charnockites of Kondapalle, their texture, mineral constituents and chemical composition, all point towards an igneous origin of this suit of rocks, later subjected to plutonic metamorphism.

Details of these studies will be published elsewhere.

The author wishes to express his deep sense of gratitude to Mr. B. V. Iyengar, M.Sc., and Mr. M. R. Sreenivasa Rao, M.Sc., for their valuable suggestions and to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., for his keen interest in the subject.

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#### EFFECT OF BIOTIN ON NITROGEN CONTENT OF YEAST

THE "biotin effect", or the rise in the respiratory and growth-rate of biotin-free yeast (*S. cerevisiae*) on the addition of biotin in the presence of assimilable nitrogen, has been noted by Winzler and co-workers.<sup>1</sup> But an adverse effect on the nitrogen content of yeast was observed by Hartelius<sup>2</sup> on the addition of biotin in the presence of  $\beta$ -alanine or pantothenic acid, while thiamin or glutamic acid raised the nitrogen content.

The present note is a report of the effect of biotin on the nitrogen content of *S. cerevisiae*.

TABLE I  
Effect of biotin on the nitrogen content of yeast

Period of incubation in hours	Total N <sub>2</sub> in mg./ml.	
	With Biotin	Without Biotin
0	0.7467	0.7467
12	0.7830	0.6691
24	0.7348	0.6116
36	0.7104	0.6148
48	0.7298	0.5961
60	0.7138	0.5818
72	0.6951	0.5890

TABLE II  
Effect of biotin on nitrogen content and growth-rate of yeast

Period of incubation in hours	With Biotin		Without Biotin	
	Total N <sub>2</sub> mg/ml	Growth*	Total N <sub>2</sub> Mg/ml	Growth*
0	0.7050	14.0	0.7050	14.0
6	0.8136	25.5	0.7360	23.5
12	0.7697	32.5	0.6298	27.0
18	0.7433	32.5	0.6272	29.5
24	0.7392	32.5	0.6194	29.5

\* Expressed as deflection of galvanometer.

observed on comparing the growth on an all-vitamin medium with that on a biotin-free

subsequent fall in the values. Yeast grown on a biotin-free medium shows a slight increase in nitrogen in the first six hours, but there is a sharp decline after this period. In no case, however, does the nitrogen content of yeast on a biotin-free medium approach that of yeast on an all-vitamin medium. The slight increase of nitrogen in the biotin-deficient yeast during the first six hours may be due to traces of biotin initially present in the yeast cells.

It was of interest to study the response of yeast cells grown on biotin-deficient medium and to additions of optimal and suboptimal doses of biotin. Table III gives the effect of addition of 5  $\mu$ g. and 0.8  $\mu$ g. of biotin to yeast grown for 12 hours on a biotin-free medium.

There is a marked increase within 6 hours in the nitrogen content of yeast when an optimum quantity (5  $\mu$ g.) of biotin is added. Even a sub-optimal dose (0.8  $\mu$ g.) increases the nitro-

TABLE III

Without Biotin						With Biotin			
0 Hours		12 Hours		18 Hours		18 Hours 5 $\mu$ g Biotin		18 Hours 0.8 $\mu$ g Biotin	
Total N <sub>2</sub> mg/ml	Growth*	Total N <sub>2</sub> mg/ml	Growth*	Total N <sub>2</sub> mg/ml	Growth*	Total N <sub>2</sub> mg/ml	Growth*	Total N <sub>2</sub> mg/ml	Growth*
0.8283	13.5	0.5913	27.5	0.5926	30.0	0.7718	31.0	0.6693	30.5

\* Expressed as deflection of galvanometer.

medium. The former<sup>3</sup> was made up of glucose, saline buffer, ammonium sulphate, l-aspartic acid and 1.5  $\mu$ g. each of thiamin, pyridoxine, riboflavin, calcium pantothenate and nicotinic acid, 7  $\mu$ g. of biotin and 55  $\mu$ g. of inositol in 5 ml. total volume of medium and inoculum. The yeast from a 24-hour slant was grown in 50 ml. conical flasks, each flask containing 4.5 ml. medium and 0.5 ml. inoculum for 36 hours at 28° C.

The yeast was then centrifuged, washed five times with 0.9 per cent. saline under sterile conditions, and suspended in saline, adjusting it to the required turbidity for the inoculum. The turbidity was photoelectrically measured with 0.5 ml. of the inoculum diluted to 10 ml. It was then inoculated into the all-vitamin medium (A) and into biotin-free medium (B). The total nitrogen content of the inoculum, and of yeast grown on A and B at intervals, was determined with 1 ml. of the suspension by the microkjeldahl method.

The growth of the yeast was measured photoelectrically at stated intervals after diluting the contents to 10 ml.

Tables I and II show the effect of biotin on the growth and assimilation of nitrogen by yeast cells. During the first six hours there is 15 per cent. increase in the nitrogen content of yeasts grown on an all-vitamin medium with

gen content. These results lend further support to the fact that biotin influences the uptake of nitrogen by yeast.

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1. Winzler, R. J., Burk, D., and du Vigneaud, V., *Arch. Biochem.*, 1944, 5, 25. 2. Hartelius, V., *Naturwissenschaften*, 1942, 30, 660. 3. De Souza, V. and Sreenivasaya, M., *J. Sci. Ind. Res.*, 1946, 4, 647.

#### THE POSSIBLE SIGNIFICANCE OF THE NUCLEIC ACID METABOLISM IN RELATION TO PENICILLIN BACTERIOSTATIS

Much of the nitrogen and phosphorus in the living cell exists in the form of nucleoproteins, constituting the chromatin which acts as the carrier of genes. These nucleotides and their derivatives are distributed among the vital elements of the cells both in the nucleus and

in the cytoplasm and play important roles in cell reproduction,<sup>1-3</sup> thus forming the most characteristic and active constituents of living matter.

In a series of experiments carried out to elucidate the mechanism of action of penicillin, working with gram positive organisms like *Staph. aureus*, *Strept. viridans* and *B. subtilis*, we have shown that nucleic acids (pure samples of nucleic acids obtained from B.D.H. was used) possess the property of antagonising penicillin action.<sup>3</sup> Organisms which are rendered non-viable by prolonged contact with penicillin are revived in the presence of added nucleic acids, so that they are enabled to grow and multiply in the normal manner. We also observed that nucleic acids can restore original morphological characteristics to cells which undergo changes in shape and gram-staining reaction due to penicillin contact.<sup>4</sup> Indeed the work of Avery *et al.*,<sup>5</sup> McCarty,<sup>6</sup> establishing that the active substance responsible for transformations in pneumococcal types is a specific nucleic acid of the deoxy ribose type, is very interesting and significant in this connection. On the basis of these and other observations we have suggested that penicillin interferes with certain phases in the metabolism of the organisms where nucleic acids feature either as metabolites helping cell-division or function as respiratory catalysts or as both.

Metabolic rate is at its maximum during the growth phase of the bacteria, and the observations of many workers<sup>7-10</sup> support the conclusion that young rapidly growing organisms are the ones which are most susceptible to the action of penicillin and that substances in the media which enhance the growth of the bacteria seem to render them more sensitive to its action. Again, it has been observed that if the bacteria are inoculated into a medium which is lacking in some of the growth requirements, the efficiency of the penicillin is definitely lowered. Further, the fact that penicillin apparently does not affect the bacteria in the resting stage as shown by its failure to produce morphologic or cultural changes in very old cultures or when maintained at low temperatures proves that this is not merely a physical or chemical effect on the body of the bacterial cell but one that influences some phase of the organisms, metabolic and reproductive activity.<sup>11</sup> These remarks point to a very striking correlation existing between the cellular components such as the nucleic acids, active in cell reproductivity processes and the inhibitory action of penicillin on them.<sup>3-4</sup>

These observations raise the important issue of the condition of the host and the presence or otherwise of nucleic acids and related products in blood and tissue fluids during the progress of the disease. The response of the host to penicillin treatment would naturally be determined by such factors. Further studies bearing on these aspects are in progress.

Our thanks are due to Prof. V. Subrahmanyam and Major K. P. Menon for their kind interest in the work and helpful discussions and also to the Council of Scientific and Industrial Re-

search under whose auspices this work is being undertaken.

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1. Malmgren, B., and Heden, C. G., *Nature*, 1947, 159, 577.
2. Claude, A., *Biol. Symp.*, 1943, 10, 112.
3. Pandalai, K. M., and George, M., *Brit. Med. Jour.*, 1947, 2, 210.
4. —, (under publication).
5. Avery, O. T., MacLeod, C. M., and McCarty, M., *J. Exp. Med.*, 1944, 79, 137.
6. McCarty, M., *Bact. Rev.*, 1946, 10, 63.
7. Chalm, E., and Duthie, E. S., *Lancet*, 1945, 248, 652.
8. Hobby, G. L., and Dawson, M. H., *Proc. Soc. Exp. Biol. and Med.*, 1944, 56, 181.
9. Miller, C. P., and Foster, A. Z., *Ibid.*, 1944, 56, 205.
10. Rant, L. A., and Kirby, W. M. M., *J. Immunol.*, 1944, 48, 335.
11. Fisher, A. M., *J. Bact.*, 1946, 52, 539.

#### BIOLOGICAL VALUE OF "SOYA-BEAN MILK" PROTEINS BY REGENERATION OF LIVER PROTEIN IN THE RAT

THE rate of regeneration of liver protein in the rat following a period of fast is an index of the nutritive value of the protein fed.<sup>1-4</sup> Recent work<sup>3,4</sup> has amplified this simple and rapid method of assay of the biological values of proteins and defined the experimental conditions for obtaining accurate results. It has been shown that the labile protein of the liver represents true liver cytoplasm.<sup>2</sup> The sulphur-containing amino-acids play an important part in liver protein synthesis.<sup>3</sup>

The biological value of soya-bean milk proteins as compared with casein has been assessed by this method, the experimental technique being essentially the same as that adopted by Harrison and Long.<sup>3</sup>

Adult albino rats of both sexes weighing 150-200 gms. were fed for about a week with a stock synthetic diet of casein, wheat flour, coconut oil, minerals and vitamins. The animals were then divided into groups comparable in regard to number, sex, and body-weight distribution. They were fasted 48 hours and fed the experimental diets, one containing casein and the other the proteins of "soya-milk", at a level of 10 per cent. A protein level of 10 per cent. was chosen for comparison in order to obtain marked effects of any deficiencies in the test protein during the rather short experimental period.

The proteins of soya-milk<sup>5</sup> were precipitated at pH 4.2, and subsequently dried at 40° C.

The experimental diets were isocaloric and contained in addition to protein, corn starch 66 per cent., cane-sugar 10 per cent., coconut oil 10 per cent. and Wesson's salt mixture<sup>6</sup> 4 per cent. Adexolin and Squibb's yeast tablets supplemented with adequate amounts of thiamine and riboflavin provided the vitamin requirements. The protein in the yeast tablets constituted only 0.69 per cent. of the diet and was common to both. A 12 gm. ration of the

Group	Number of Rats	Protein fed during the period gms.	Liver protein nitrogen mgm/100 gm. of b.w.	Liver fat Gm/100 gm. of b.w.	Liver protein nitrogen increment over fasting level
Controls	12	..	110 $\pm$ 2.0*	0.174 $\pm$ 0.01*	..
Fasted 48 hrs.	6	0.0	83 $\pm$ 2.4	0.160 $\pm$ 0.01	..
Refed 10% casein diet					
2 days	6	2.2	108 $\pm$ 2.5	0.205 $\pm$ 0.02	25
4 days	6	4.2	110 $\pm$ 3.0	0.185 $\pm$ 0.018	27
Refed 10% soyabean protein diet					
2 days	6	2.2	105 $\pm$ 2.2	0.201 $\pm$ 0.02	22
4 days	6	4.2	105 $\pm$ 2.0	0.197 $\pm$ 0.015	22

\* Mean  $\pm$  standard error of the mean

diet was fed to each rat on the first day, and 10 gms. on the succeeding days of re-feeding. The average caloric intake of the animals during the re-feeding period was 24-26 cal./100 gms. body-weight, and fulfilled in this respect the important condition laid down by Kosterlitz and Campbell.<sup>4</sup>

At the ends of the appropriate experimental periods, the groups of rats were anaesthetized with amylal and exsanguinated through the abdominal aorta in order to ensure minimum and approximately uniform amount of residual blood in the livers. The whole liver was then excised from each animal and dried to constant weight at 95° C. The dried liver was ground to a fine powder and aliquots taken for total nitrogen and total lipid estimations.<sup>3</sup> The true protein nitrogen value of the liver was calculated as the difference between the total nitrogen and the non-protein nitrogen which was determined by analysing separately a 5 per cent. trichloroacetic acid extract from an aliquot of the liver powder.

The results obtained have been tabulated below. All values are expressed in terms of body-weight (b.w.), the reference weight used for calculation for both the fasted and the re-fed animals being the body-weight immediately prior to the fast.

The above results show clearly that on the basis of the liver protein nitrogen increments over the fasting level in the two groups, the biological value of the soya-bean milk proteins works out to 81.5 per cent. that of casein. This value is slightly lower than those obtained by other methods<sup>6</sup> presumably because the soya-bean proteins are relatively low in methionine content<sup>7</sup> which is one of the important limiting factors in respect of liver protein regeneration.<sup>3</sup>

We wish to thank Prof. V. Subrahmanyam for his kind interest in the above work.

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1. Addis, T., Poo, L. J., and Lew, W., *J. Biol. Chem.*, 1938, **116**, 343.
2. Kosterlitz, H. W., *Nature*, 1944, **154**, 207.
3. Harrison, H. C., and Long, C., N. H., *J. Biol. Chem.*, 1945, **161**, 545.
4. Kosterlitz, H. W., and Campbell, R. M., (a) *Nature*, 1946, **157**, 628; (b) *J. Physiol.*, 1945, **104**, 16.
5. De, S. S., and Subrahmanyam, V., *Curr. Sci.*, 1945, **14**, 204.
6. Desikachar, H. S. R., De, S. S., and Subrahmanyam, V., *Ann. Biochem. Expt. Med.*, 1946, **6**, 49.
7. (a) Block, R. J., and Bolling, D., *Arch. Biochem.*, 1943, **3**, 217; (b) Evans, R. J., *Ibid.*, 1945, **7**, 439.
8. Wesson, *Science*, 1932, **75**, 339.

### PROLONGATION OF INSULIN EFFECT BY COMBINING IT WITH CASEIN-HYDROLYSATE

Two well-known preparations (1) Protamine-Zn-Insulin<sup>1</sup> and (2) Globin-Insulin with Zn are now widely used in the treatment of Diabetes Mellitus. The prolonged hypoglycaemic action of the first compound has been attributed to its comparatively low solubility at the pH of blood and tissue fluid and the consequent slow rate of absorption of Insulin in the body. Reiner *et al.*<sup>2</sup> after studying various Insulin preparations came to the conclusion that the rate of absorption of Insulin was determined not only by the insolubility of the preparation employed but by other factors as well. These authors described a preparation, Globin-Insulin which is believed to be a loose combination of Globin and Insulin. The onset of hypoglycaemia with this preparation is rapid when compared with protamine-Zn-Insulin, but its disappearance slow when compared with ordinary Insulin.

Both these preparations are combinations of Insulin with other proteins. It appears to us that Insulin has also the property of combining with 'simple peptides'. When this combination is injected into the body, the Insulin is released gradually and the nature of the hypoglycaemic effect is determined by the rate at which the hormone is absorbed. In order to test this hypothesis, attempts have been made by us to mix Insulin with a casein-hydrolysate, "Pro-nutrin" (an enzymic digest of casein prepared by Herts Pharmaceutical Ltd., Welwyn Garden City, England) which contains a mixture of



simple peptides. Such combinations do not appear to have been given a trial.

We are briefly reporting the results obtained by a subcutaneous injection of Insulin (2 c.c. of 40 units/c.c., Lilly Co.) combined with casein-hydrolysate (2 c.c. of 2 per cent. 'Pro-nutrin') and zinc chloride (0.7 mg.). The resulting solution was adjusted to pH 3.4, with decinormal HCl; and it was found to be slightly opalescent. The proportion of zinc salt added has been kept more or less constant as in the two other Protein-Insulin preparations. Each of the preparations was tried on batches of 25 rabbits with 1 unit per rabbit.

Preparation injected	Average Blood Sugar (Mgm. per cent.)				
	0 hrs.	2 hrs.	4 hrs.	5 hrs.	24 hrs.
Ordinary Insulin ..	125.0	67.0	98.0	122.0	124.0
Protamine-Zn-Insulin	124.0	90.0	69.0	61.0	100.0
Globin-Zn-Insulin	124.0	68.0	72.0	85.0	107.0
Casein-Hydrolysate-Zn-Insulin	122.0	88.0	72.0	75.0	105.0

There appears to be a definite prolongation of the hypoglycaemic effect when Insulin is mixed with casein-hydrolysate. The intensity of the effect appears to be intermediate between those of Globin-Insulin and Protamine-Zn-Insulin. Further studies are in progress and the details will be published elsewhere.

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1. Hagedorn, *et al.*, *J. A. M. A.*, 1936, 105, 3, 177.
2. Reinner, *et al.*, *J. Pharmacol. and Exper. Therap.*, 1939, 67, 330.

### INDIAN HENBANE

*Hyoscyamus niger* or *Henbane* is a well-known medicinal plant which is extensively used for its sedative properties. In India the plant grows wild at an altitude of 5,000 to 9,000 ft. above sea-level in the temperate Himalayas. It has also been cultivated as a winter crop in the plains in such places as Saharanpur, Lyallpur, etc. In Kashmir the plant grows wild throughout the valley and on rubbish heaps, dry drains and outskirts of villages.

Although the supply of *Hyoscyamus niger* from Indian sources has been meeting to some extent the demand of the market in this country, yet it has been reported that the *Hyoscyamus* leaves from various localities in India are of poor quality,<sup>1</sup> much below B.P. standards.

Chemical analysis<sup>2</sup> of samples of leaf obtained in Kashmir Valley and other parts of India from both wild and cultivated plants was carried out. The leaves were collected at the flowering stage of the plant, dried partly in sun and partly in shade before analysis. The results are tabulated below:—

Locality	Altitude (ft.)		Percentage of total alkaloids
Drang	7,500	Wild	0.076
Yarikah	7,100	Cultivated	0.084
		Cultivated	0.074
Gulmarg	9,000	Wild	0.066
N.-W.F.P.	3,000	Wild	0.047
N.-W.F.P.	1,100	Wild	0.031
Lyallpur	800	Cultivated	0.025
Saharanpur	..	Cultivated	0.035
Commercial samples of Kashmir-Grown <i>Hyoscyamus</i> (from Utilisation Division, Baramulla)			
1945 crop			0.058
1946 crop			0.062
B.P. 1932 standard			0.05
U.S.P. XII standard			0.04

The table shows that *Hyoscyamus niger* leaves growing wild or cultivated in Kashmir at altitudes of over 5,000 feet above sea-level give alkaloid contents well up to and even above B.P. and U.S.P. standards.

The leaf grown at lower altitudes or in the plains has a lower content than the B.P. and U.S.P. standard. The Forest Department of Kashmir State is planning to extend the cultivation of *Hyoscyamus* at suitable altitudes, and it is hoped that good quality leaves will be available to the medical profession on an extensive scale. So far the quantities of good leaf have been very limited.

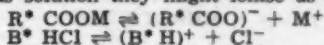
We are grateful to Col. Sir R. N. Chopra for valuable advice in the course of investigation.

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1. Chopra and Ghosh, *Indian J. Med. Res.*, 1923, 13, 533.
2. B. P. (1932) addendum (1936).

### VALUE OF $[M]_D$ FOR CAMPHOR- $\beta$ -SULPHONATE ION IN WATER

CAMPBOR- $\beta$ -sulphonic acid is a strong acid and its salts easily ionise in water. For optically active substances which ionise in water Hadrich<sup>1</sup> offered the suggestion that in dilute aqueous solution they might ionise as follows:



where  $R^*$  and  $B^*$  are optically active acid and base respectively and the rotations of such solutions are due wholly to the anion in the former case and cation in the latter. Prior to this explanation Landolt<sup>2</sup> has shown that molecular rotations of Li, Na, K and  $\text{NH}_4$  salts

Camphor- $\beta$ -sulphonates of :—		Temp. °C.	d-salt		l-salt	
			Conc. g./100 c.c.	[M] <sub>D</sub>	Conc. g./100 c.c.	[M] <sub>D</sub>
1	Ammonium <sup>7</sup>	35	1.0000	+51.05°	1.0016	-49.71°
2	o-Toluidene <sup>8</sup>	27-28	4.0032	50.86	4.0048	52.11
3	m-Toluidene <sup>8</sup>	29-30	4.0040	49.83	4.0060	51.19
4	p-Toluidene <sup>8</sup>	29	4.0040	52.88	4.0032	53.39
5	o-Chloraniline <sup>9</sup>	35	1.0016	51.98	1.0000	52.13
6	m-Chloraniline <sup>9</sup>	35	1.0000	55.72	1.0008	57.49
7	p-Chloraniline <sup>9</sup>	35	1.0008	53.91	1.0000	53.93
8	$\beta$ -Naphthylamine <sup>8</sup>	35	1.0000	54.96	1.0008	56.20
9	ar-tetrahydro- $\alpha$ -naphthylamine <sup>8</sup>	35	1.0000	45.47	1.0016	47.19
10	Aniline <sup>8</sup>	26	4.0056	52.38	4.0044	51.36
11	p-aminobenzene-sulphonamide <sup>7</sup>	35	1.0016	52.46	1.0008	52.52
Mean Value =				+51.96		-52.46

of d-tartaric acid approached the same value as the solutions were more and more diluted. Oudemans<sup>3</sup> had also obtained similar results with salts of quinine with different acids. Similar studies were carried out on metallic salts of d-camphor- $\beta$ -sulphonic acid<sup>4</sup> by Thomas and Jones<sup>5</sup> and Graham.<sup>6</sup> These authors arrived at the mean value of [M]<sub>D</sub> = 52° for the camphor- $\beta$ -sulphonate ion. The present author has examined a number of salts of d- and l-camphor- $\beta$ -sulphonic acid with primary amines. The results are recorded in the table.

The mean value of [M]<sub>D</sub> for camphor- $\beta$ -sulphonate ion, namely, [M]<sub>D</sub> = +51.96° for d- and [M]<sub>D</sub> = -52.46° for l-isomer agrees well with the value obtained by Graham for d-camphor- $\beta$ -sulphonate ion. These results further indicate that primary amine salts of active camphor- $\beta$ -sulphonic acids are more or less fully ionised in 1-4 per cent. solution in water at 26-35° C.

Further work on the degree of ionisation of salts of active camphor- $\beta$ -sulphonic acids is in progress.

Department of Chemistry,  
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1. Hadrich, Z. *Physikal. Chem.*, 1893, **12**, 476.
2. Landolt, *Ber.*, 1873, **6**, 1077.
3. Oudemans, *Annalen*, 1876, **52**, 1876.
4. Reychler, *Bull.*, 1838, (iii) **19**, 120.
5. Thomas and Jones, *J. C. S.*, 1906, **89**, 284.
6. Graham, *Ibid.*, 1912, **101**, 746.
7. Singh, B. K. and Perti, O. N., *Proc. Ind. Acad. Sci.*, (A), 1945, **22**, 84.
8. Singh, B. K., Perti, O. N., and Singh, B. N., *Proc. Lahore Phil. Soc.*, 1944, **6**, 15.
9. —, *Proc. Ind. Acad. Sci.*, (A), 1945, **22**, 205.

### CHROMOSOMAL CHANGES AND NUTRITIONAL REQUIREMENTS OF YEASTS

CHANGES in the chromosomal constitution of organisms have been known to produce changes in morphological and physiological characteristics.<sup>1</sup> Ever since the discovery of "bios" by Wildiers<sup>2</sup> a good deal of work has been done on the nutritional requirements of various strains of yeasts which has led to the discovery

of a number of members of the B-complex vitamins. On the basis of their response to B vitamins, a classification of yeasts has been suggested.<sup>3</sup> But in yeasts, as in higher organisms, a rational approach to the problem of differences in biochemical characteristics should be based on chromosome and genetic constitution of the various strains. In this laboratory a brewery strain BY 1 was shown<sup>4</sup> to have two chromosomes and by treating it with acenaphthene, a tetraploid,<sup>5</sup> BY 3, and a mutant having two unequal chromosomes,<sup>6</sup> BY 2, have been isolated. The strains BY 1 and BY 3 are bottom yeasts while BY 2 is a top one. It was thought, therefore, that an elucidation of the changes, if any, in the vitamin requirements accompanying the changes in the chromosome constitution would be interesting.

The basal medium contained glucose 20 gms., salts solution 125 ml., citric acid citrate buffer of pH 4.5 100 ml., ammonium sulphate 4.0 gms., asparagine 100 mgm., acid hydrolysed casein 2.5 gms., tryptophane 50.0 mgm., cystine 100.0 mgm., thiamin, riboflavin, pyridoxin, nicotinic acid, p-aminobenzoic acid and calcium pantothenate 800  $\mu$ g. each, biotin and folic acid 800  $\mu$ g. each, inositol 20 mg., and choline 1.0 mg. in one litre. 5.0 ml. of this medium was added to each of the flasks and sterilized at 15 lbs. pressure for 15 minutes. The inoculum was made by suspending the growth from a 24-hour wort-agar slant in 0.89 per cent. saline to give a concentration of 1 mg. of moist yeast per ml. and 0.2 ml. of this suspension was inoculated into each flask. After incubating the flasks at 28° C. for 21 hours, the growth was measured with a Lumetron turbidometer.

The observations indicate that for BY 1 and BY 3 inositol, thiamin, pantothenate and biotin are absolutely essential and that pyridoxin is an accessory factor under the conditions employed. Both these strains show no growth in the absence of all the vitamins. Riboflavin and choline have an inhibitory effect on all the three strains. The similarity of the response of the tetraploid, BY 3, to that of the control strain, BY 1, is not surprising since that is what should be expected if a mere duplication of the chromosomes is unaccompanied by any gene mutations.

TABLE I  
Growth expressed as percentage absorption after 21 hours

Medium	-Thiamin	-Riboflavin	-Pyridoxin	-Nicotinic acid	-Pantothenate	-p. amino Benzoic acid	-biotin	-Inositol	-Folic acid	-Choline	All vitamins	No vitamins
BY 1 Control	4.0	100	38.5	78.0	2.5	87.5	17.5	1.5	86.0	100	84.5	0.5
diploid, bottom yeast	4.0	100	40.0	75.5	2.0	83.0	19.0	1.0	87.5	98	80.5	0.5
BY 2 mutant	38.0	100	56.0	60.0	61.5	61.0	30.0	67.0	62.0	100	72.0	26.0
top yeast	36.0	99.5	57.5	58.0	58.5	59.0	27.0	65.0	64.5	96.0	68.0	27.5
BY 3 tetraploid	1.5	99.5	20.5	89.0	2.5	83.0	9.5	0.0	89.0	93.5	85.5	0.0
bottom yeast	0.0	100	26.0	91.0	1.5	82.5	12.0	0.0	83.0	95.0	85.0	0.0

The behaviour of the top yeast, BY 2, is highly interesting. The fact that on no vitamin medium the growth is about one-third of that in an all vitamin medium indicates that the mutation is a dominant one. From cytological investigations it was suggested by Subramaniam and Ranganathan<sup>6</sup> and Subramaniam,<sup>7</sup> that the change may be the result of the deletion of a bit of one of the chromosomes. The growth in the medium without biotin and without thiamin is about the same as that in no vitamin medium. Quite unlike BY 1 and BY 3 this strain grows well on media lacking pantothenate or inositol, which means that on becoming a top yeast, it has either acquired the capacity to synthesize the above factors or that it may not require them for growth at all. So, this relatively auto-trophic nature of the mutant indicates that it is not the case of a mere "pseudo dominance" of the remaining haploid set of genes in the normal chromosome. The work of Beadle<sup>1</sup> and his collaborators indicates that a mutation of a given gene implicates a particular enzyme. Judged on that basis, if the mutant top yeast is really the result of a chromosomal deficiency, it ought to have been accompanied by a few gene mutations. From published literature on the effect of acenaphthene on higher plants such a possibility appears to be remote. The probability, however, is a duplication of some genes in one chromosome accompanying the deficiency in the other. Winge and Laustsen<sup>8</sup> suggested that the difference between bottom and top yeasts is a quantitative and not a qualitative one. If that is so, then, the remarkable behaviour of the mutant top yeast, BY 2, is likely to be the result of a "position effect" accompanying the duplication of some genes. Occurrence of "position effects" has been demonstrated not only in animals<sup>9</sup> but also in plants.<sup>10</sup> Hence the occurrence of a "position effect" in yeast in which the chromosomes show "somatic pairing" as in *Diptera*, is not very surprising.

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1. Beadle, G. W., *Currents in Biochem. Res.*, 1941, 1-12.
2. Wildiers, E., *Cellule*, 1901, 18, 313.
3. Schultz, A., L., Atkins and C. N. Frey, *J. Bact.*, 1940, 40, 359.
4. Subramaniam, M. K., *Proc. Nat. Inst. Sci.*, (India), 1946, 12, 143.
5. Subramaniam, M. K., *Curr. Sci.*, 1945, 14, 234.
6. Subramaniam, M. K., and B. Ranganathan, *Nature*, 1946, 157, 49.
7. Subramaniam, M. K., *Sci. and Cult.*, 1946, 12, 217.
8. Winge, O., and O. Laustsen, *Compt. Rend. Trav. Lab. Carlsberg*, 1939, 22, 337.
9. Muller, H. J., *Proc. Roy. Soc.*, 1947, 134, 1.
10. Catcheside, D. G., *J. Genet.*, 1947, 31, 48.

#### ON THE PREPARATION OF PURE CULTURES OF *VORTICELLA*

Two methods have been generally followed with regard to the cultivation of protozoa in a medium containing killed or living bacteria. The older method<sup>1</sup> consists in streaking agar plates radially or by central circular smear with the bacterial strain upon which the protozoa are to be nourished. The later method<sup>2</sup> consists in replacing the bacteria associated with the protozoan by a specific strain of bacterium through change of the medium.

For freeing the protozoa from the adhering bacteria five principal methods have been employed: (a) desiccation of cysts,<sup>3</sup> (b) sterilisation of cysts employing chemicals<sup>4,5</sup> and heat,<sup>6,7</sup> (c) washing the cells in sterilised water,<sup>8</sup> (d) negative geotaxis,<sup>9</sup> and (e) cataphoresis.<sup>10</sup>

The method adopted by us for the separation of *Vorticella* sp. from the contaminating bacteria and the attempts made to culture the bacteria-free *Vorticella* in synthetic media are briefly described in this communication. The method<sup>11</sup> is based on the fact that the protozoa exhibit a geotropic response by virtue of



which the protozoa swim away from the adhering bacteria when taken through columns of sterile liquid in V-tubes or suitable pipettes.

Heat-sterilised pipettes (16-18" long and  $\frac{1}{4}$ " bore) having a tapering point and rubber tube with cotton plug and pinch cock at the large end were used for the present studies. The pipettes were filled with sterilised tap water to within 2" of the top by suction. About 2 c.c. of the culture of *Vorticella* sp. originally isolated from aerated sewage samples was carefully sucked up into the pipette so as to form the layer beneath the sterile water. The tapering end of the pipette was then sealed by heat, taking care to prevent the formation of air bubbles. The rubber tube with cotton plug attached to the pipette was then removed aseptically and some heat-sterilised yeast cells were carefully placed on the water layer and the rubber tube with the plug put back in its place. The pipette, sealed end down, was set upright in a test tube. Under these conditions even motile bacteria by their own efforts cannot reach the top in the given time. The *Vorticella* were found present at the top of the water column in about half an hour after allowing the pipettes to stand. The pipettes were left like this for 24 hours, thus giving a chance to the surface migrants to evacuate the remains of ingested microbes and to feed on the yeast material at the top of the water column. This procedure was repeated, sucking up each time beneath the fresh column of sterilised water in a fresh sterilised pipette, about 2" of fluid from the top of the previous pipette, until the top fluid containing the protozoa was free from bacteria as shown by negative results in broth cultures. This was usually accomplished after three washings. The addition of sterilised yeast cells to the top of the water column was found useful as it accelerated the migration of the protozoa.

Having obtained bacteria-free cells of *Vorticella*, attempts were made to grow them, under aseptic conditions, in artificial media. A number of media (such as the basic medium of Glaser and Coria<sup>12</sup> containing horse-serum and timothy hay extract, and the synthetic medium of Pringsheim<sup>13</sup> containing small amounts of potassium phosphate, potassium chloride, potassium carbonate, sodium acetate, magnesium sulphate, peptone, gelatin and dextrose), successfully employed by other workers for the cultivation of other forms of protozoa (such as *Trichoda pura*, *Chilomonas paramecium*, *Polytoma uvella*, *Euglenida* and *Phytomastigophora*) were tried for the *Vorticella* sp., but the growth of this protozoan in these media was found very poor. Similar observations were made by Luck and Sheets<sup>9</sup> in regard to *Euplotes* and by Glaser and Coria<sup>12</sup> in regard to *Paramecium caudatum* and *P. multimicronucleatum*.

*Vorticella*, like certain other forms of protozoa, apparently require special growth-promoting substances which are presumably available under natural conditions of their development. It is of interest in this connection to note that pantothenic acid has been found to stimulate the growth of *Glaucoma pyriformis*<sup>14</sup>; that certain of the plant hormones have a marked beneficial effect on the growth of *Euglena gracilis*<sup>15</sup>; that thiamin or pyrimidine has been found necessary for the growth of *Acanthamoeba castellanii*<sup>16</sup>; and that ascorbic acid as well as haemetin and other yet unidentified factors have been found to influence the growth of *Trypanosoma cruzi*.<sup>17</sup> In view of these observations, it would be of great interest to study the nutritional requirements of *Vorticella* and other forms of protozoa which have a vital role in sewage purification and allied processes.<sup>18,19</sup>

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1. Beijerinck, M. W., *Centraalb. f. Bakt.*, 1906, 19, 257.
2. Oehler, R., *Arch. f. Protist.*, 1920, 40, 16.
3. Tsujitani, J., *Centraalb. f. Bakt.*, Orig., 1890, 24, 666.
4. Frosch, P., *Ibid.*, 1926, 21, 1897.
5. Severtzoff, L. B., *Ibid.*, 1924, 92, 151.
6. Walker, E. L., *J. Med. Res.*, 1908, 17, 379.
7. Oehler, R., *Arch. f. Protist.*, 1924, 49, 112.
8. Hargitt, G. T., and Fray, W. W., *J. Exptl. Zool.*, 1917, 22, 421.
9. Luck, J. M., et al., *Quarterly Review of Biology*, 1931, 6, 46.
10. Amster, *Centraalb. f. Bakt.*, Orig., 1922, 89, 166.
11. Glaser, R. W., and Coria, N. A., *J. Exptl. Med.*, 1930, 51, 787.
12. Glaser, R. W., and Coria, N. A., *Am. J. Hyg.*, 1934, 21, 111.
13. Pringsheim, E. G., *Culture methods for invertebrates*, by Galtsoff et al., 1937.
14. Elliot, A. M., *Biol. Bull.*, 1935, 68, 82.
15. —, *Physiol. Zool.*, 1938, 11, 31.
16. Lwoff, A., *Compt. rend. Soc. Biol.*, 1938, 128, 455.
17. Lwoff, M., *Compt. rend. Acad. Sci.*, 1938, 206, 540.
18. Pillai, S. C., *Curr. Sci.*, 1941, 10, 84; *Ibid.*, 1942, 11, 437.
19. Pillai S. C. and Subrahmanyam, V., *Sci. and Cult.*, 1946, 11, 392.

#### NICKEL-THORIA-KIESELGUHR CATALYST FOR THE FISCHER- TROPSCHE REACTION PART I

In industrial practice in Germany, cobalt has been mostly used for Fischer-Tropsch Synthesis; nickel has not found much use though it is very much cheaper as it favours formation of methane and deteriorates rapidly. Chakravorty<sup>1</sup> considers that such deterioration is due to the traces of alkali ion present in the system. This idea has been followed up, and a catalyst has been prepared by using ammonium carbonate as the precipitant in presence of excess of carbon dioxide.

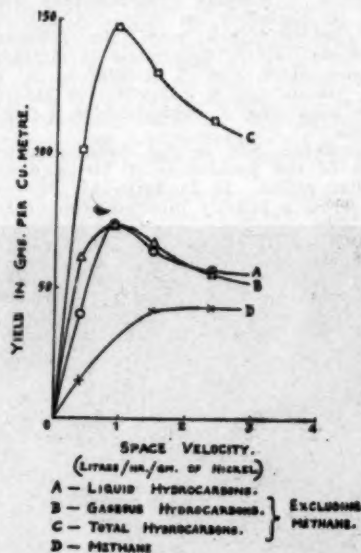
Kieselguhr, purified with  $\text{HNO}_3$ , is added to requisite quantities of thorium nitrate solution and 20 per cent. excess of nickel nitrate solution, and stirred vigorously. Carbon dioxide is passed into the solution and dilute ammonium carbonate solution added drop by drop with stirring till a faint smell of ammonia is obtained. The precipitate is filtered immediately through a Buchner funnel and washed with distilled water, dried at  $110^\circ\text{C}$ . and broken into granules which pass through 8-mesh but are retained by 12-mesh. The catalyst is then reduced at  $500^\circ\text{C}$ . for 6 hours in a current of hydrogen, prepared electrolytically.



The catalyst (5-6 c.c.) is then charged into the reaction chamber and again reduced *in situ* at 300-350° C. in a current of H<sub>2</sub> for 6 hours, and the synthesis gas is passed through the catalyst. Reactions are carried out at different temperatures and at different space velocities.

The products of reaction are passed through a glass condenser, cooled in ice where liquid hydrocarbons and water are condensed and then through four glass-stoppered U-tubes, first containing soda lime to absorb CO<sub>2</sub> and the rest containing active carbon cooled in ice, for absorbing gaseous hydrocarbons. The products of the cooled glass condenser are analysed for water by the method adopted by Smith and Bryant.<sup>2</sup>

It was observed that the best reaction takes place at 195° C. The catalyst is remarkably steady at that temperature. The results are illustrated in Fig. 1.



From the graph it is observed that the catalyst yields at atmospheric pressure, 147.5 gms. of hydrocarbons, excluding methane per cubic metre of synthesis gas with a space velocity of 0.90 litres per hour per gram of nickel in the catalyst which compares well with that used in industrial practice.

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September 17, 1947.

1. Chakravorty, K. M., *Science and Culture*, 1938, 3, 366. 2. Donald Milton Smith and Bryant, W. M. D., *J. Am. Chem. Soc.*, 1935, 57, 841.

#### NOTE ON THE DETERIORATION IN GERMINATION-CAPACITY OF A PADDY STRAIN IN MALABAR AND SOUTH KANARA

SOME varieties of rice seeds like *Garikesannavari* of the Godavari delta and the *Boro* rices of Orissa, are found to lose viability if they are stored in receptacles which are not air-tight, like loose gunnies, straw-twist bundles or cloth bags.

More or less the same type of deterioration was noticed a few years ago in the case of Co. 3 strain (Coimbatore Vellai samba) cultivated in Malabar and South Kanara, where it is sown in August-September and harvested in December-January. Locally the harvested grains are dried and stored in straw-twist bundles or other non-air-tight receptacles till the time of next sowing in August-September. The seeds thus pass through the wet weather period of the south-west monsoon which usually records about 60 to 80 inches of rain in the two months of June and July and deteriorate as indicated by low germinability unlike those preserved in metallic or air-tight receptacles.

In the course of an investigation to find out a simple and effective method of overcoming this defect, it has been possible to establish a fairly close correlation between the deterioration in the germination and the capacity of the grains to germinate immediately after harvest, with a value for  $r = +0.7068$ .<sup>1</sup>

The kernels of the deteriorating types have, besides, a flinty appearance; they expand better on cooking immediately after harvest than non-deteriorating types. In the dry state as seed, they show a marked capacity to absorb more moisture. These facts would suggest that they might have undergone a process of intense desiccation in the field during the maturing phases of the grain.

It is common observation that in rice, the ripening of the grain and the ripening of the foliage do not always go together; in some varieties earheads ripen while the straw is still green, while in others the two processes synchronise; in still others the straw ripens and lodges before the grains reach full maturity. Thus the ripening of the ear and the attendant transformations of the contents in the grain might be independent features conditioned by atmospheric humidity, intensity of sunlight, diminishing supply of water, etc. Continual decrease of the water content is a significant feature of this process of ripening; even the important role of enzymes may be conditioned, above all, by the amount of moisture the grain holds at successive stages of dehydration which in turn might determine the nature and proportion of the different carbohydrates in the grain at the time of harvest.

This line of thought suggested that if the process of hydration and dehydration taking place in the ripening grains on the plant, is followed on after the harvest of the grains also, gradual dehydration could be induced in contrast to rapid desiccation and the defects of the seeds could be got over.

From the results of a series of experiments conducted with different periods of soaking and

drying, it is seen that deterioration could be very successfully checked if the seeds are soaked in water for about 5 minutes and immediately dried, taking care to see that they do not dry to excess. From 80 to 100 per cent. germination was obtained this way while the control gave only 12 to 30 per cent. The treatment, as simple as it is effective, does not affect the yield, either of grain or straw, of the succeeding crop.

Pan<sup>2</sup> has found that seeds soaked in a 2 per cent. solution of copper sulphate for a short time, dried and stored, kept their viability longer but the rate of germination was slow. On the basis of the above results it might be that it is the action of water that had induced longer viability in these experiments.

The effect of water treatment may be purely a physical one—a mere 'hardening' process, or it may be the result of an increase in hygroscopic moisture which is not lost on subsequent drying, in which case, the results so far obtained would indicate that seeds with minimum hygroscopic moisture keep well in quite air-tight receptacles while in aerobic storages, more hygroscopic moisture is needed. Thus a certain relationship would seem to exist between the moisture in the seed and the atmospheric humidity acting on it in storage.

Saran<sup>3</sup> working on the viability of paddy seeds has observed (1) that seeds which contained 10 to 12 per cent. moisture at the time of storage deteriorated even in air-tight receptacles, (2) that they remained viable in receptacles with desiccating agents and (3) that the same seeds kept up viability without desiccating agent when the moisture was brought down, by drying, to 3.6 to 4.5 per cent.

These observations lend support to the view that for successful storage, the seed and its environment have to be in a certain equilibrium as regards moisture content. Based on the ratio of the humidity of the surrounding atmosphere and the internal moisture content of the seed it may be possible by extensive and well-planned experiments to establish a general law governing its germination.

Though it has been possible to solve the problem of deterioration by a simple treatment, the internal background, genetic and physiological, that might differentiate the deteriorating and the non-deteriorating types, remains to be investigated.

Sreenivasan<sup>4</sup> has suggested that the activity of the  $\alpha$ -amylase in rice grain has a close relationship to the extent of swelling on cooking. This swelling capacity would seem to be positively correlated with the germinability of the seeds immediately after harvest, which in turn has a direct relationship to the extent of deterioration in aerobic storage. It is quite probable that the expansion on cooking and immediate post-harvest germinability are determined by the nature of the starch complex in the grain. A study, therefore, of the different carbohydrates and their proportions as also the enzymic activity in the maturing endosperm of the different varieties of rice might throw much light on this problem of deterioration.

The lines of investigation indicated above are

being pursued and a full report will be published in due course.

P. C. SAHADEVAN.

M. B. V. NARASINGA RAO.

Agri. Research Station,  
Pattambi,  
May 28, 1947.

1. Ramiah, K. "Rice in Madras," 1927. 2. Pan, C. B., *J. Amer. Soc. Agron.*, 1936, **28**, 985. 3. Saran, A. L., *Curr. Sci.*, 1945, **10**, 271. 4. Sreenivasan, A., *The Indian Jour. Agr. Science*, 1938, **9**, 208.

### SOME NEW HOSTS FOR STRIGA

THE members of the genus *Striga* are parasitic on many graminaceous plants, some of which are important food crops. Of these, *Striga densiflora* and *S. lutea* have been known to attack sorghum (*Sorghum vulgare*) in this province. In Bombay Province they are reported to parasitise on crops of the Italian millet (*Setaria italica*) and Bajra (*Pennisetum typhoideum*) also.<sup>1</sup> Sugarcane is attacked by *S. euphrasioides* and *S. densiflora* in India<sup>2</sup> and *S. hirsuta* and *S. parviflora* in Mauritius.<sup>3</sup> Besides sugarcane, *S. euphrasioides* is found on rice also.

No instance has so far been reported in Madras of the parasitism of *Striga densiflora* on Italian millet. In January 1947, the author came across a heavily infected crop of *Setaria*



FIG. 1. *Striga densiflora* on *Eleusine coracana*. The arrow points to the young underground shoots of *Striga*.

*italica* in a field of the Central Farm, Coimbatore. The species of parasite, involved was almost exclusively *Striga densiflora*. An observation made at this time was the attack of *Striga densiflora* on Ragi (*Eleusine coracana*). A few stray ragi plants were found in a field of Italian millet with *Striga densiflora* growing quite close to them. When these were dug up with the earth surrounding them and carefully washed, it was found that the *Striga* had well-formed connections with the ragi plants. One or two of the underground shoots of *Striga* were also found. Fig. 1 shows the aerial shoots of *Striga densiflora* and a small underground shoot among the roots of the ragi plants.

The occurrence of *Striga* on ragi has been observed by Coleman<sup>4,5</sup> in Mysore as early as 1916, but the species of parasite involved has not been mentioned. However, in a recent account of the diseases of ragi, Venkatarayan<sup>6</sup> has recorded *Striga lutea* as the parasite affecting this crop in Mysore. Another species of *Eleusine*, *E. aegyptiaca* (*Dactyloctenium aegyptiaca*) was recorded as a host of *Striga densiflora*.<sup>1</sup> But as this grass is no longer considered to be a member of the genus *Eleusine*, but is included under *dactyloctenium*, the present record appears to be the first authentic case of the parasitism of *Striga densiflora* in the genus *Eleusine*.

#### Other Hosts:

*Striga densiflora* was found parasitising the following grasses also, *Brachiaria eruciformis* Griseb. (*Panicum isachne* Roth.), *Tragus racemosus* Scop., and *Eragrostis Willdenoviana* Nees. Of these, the specie of *Eragrostis* has

among the fallow plots surrounding the Research Institute. This was a grass, *Tragus racemosus* Scop., which has so far been known



FIG. 3. *Striga lutea* on *Tragus racemosus* Scop.

to be the host of *Striga densiflora* only<sup>1</sup> (Fig. 3).

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Lawley Road P.O.,  
Coimbatore,  
July 20, 1947.

1. KUMAR, L. S. S., and Solomon, S., *Proc. Ind. Acad. Sci.*, B, 1941, 13, 131.
2. Luthra, J. C., *Agri. J. India*, 1921, 18, 519.
3. Bell, A. F., and Cottrell-Dormer, W., *Queens. Agri. J.*, 1931, 36, 463.
4. Coleman, L. C., *Rept. Agr. Dept. Mysore*, 1916-17, 1917, 5, -.
5. *Dept. Agr. Mysore State, Gen. Ser. Bull.*, 11, 1920.
6. Venkatarayan, S. V., *Mysore J. of Agri.*, 1946, 24, 60.
7. Van Borren, H. L., *Poona Agri. Coll. Mag.*, 1915, 5, Nos. 3 and 4.

#### VIVIPARY IN PYRUS MALUS

VIVIPARY is a common phenomenon in the mangoes and jack fruit. It has also been reported to occur in mangoes and some grasses.

An apple was purchased at Cuddapah, and the fruit looked quite healthy but not heavy. When the fruit was cut open the outer fleshy portion was found to be spongy. Inside there were 8 healthy seedlings and 2 seeds. The length of the seedlings was about one inch. The broken testa was in tact and all the seedlings were loosely attached to the central axis. The apple was not at all sweet as the seedlings had evidently utilised much of the sugar for their germination and growth.

Agri.-Met. Section,  
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Poona,  
August 27, 1947,

V. K. S. MANI,



FIG. 2. *S. densiflora* on *Eragrostis Willdenoviana* Nees\*

not been reported as a host of *S. densiflora*. Though Van Burren<sup>7</sup> has recorded a specie of *Eragrostis* as a host of *S. densiflora*, he has not mentioned the exact specie. Fig. 2 shows the parasitic connections between *Striga* and *Eragrostis*.

A new host for *Striga lutea* was discovered

## REVIEWS

**Chemistry of Muscular Contraction.** By A. Szent-Gyorgyi. (Academic Press Inc., N.Y.), 1947. Pp. 150. Price \$ 4.50.

Modern Physiology of Muscle may be said to have begun the classical experiments of Fletcher and Hopkins in 1907. But their theory that formation of lactic acid from glycogen was the initial event in the activity of muscle and that lactic acid, acting upon the contractile substance, was responsible for initiating the contraction, could not be sustained in the light of subsequent discoveries, even though the glycogen-lactic acid conversion has been confirmed and found to be the main energy-yielding mechanism, and further details regarding the enzymatic breakdown of glycogen have been established by the later brilliant work of Meyerhof, Embden, Warburg, Von Euler, Lundsgaard and others. With the discovery of phospho-creatine in muscle by the Eggletons and Fiske and Subba Row, in 1927 and of adenosine-triphosphate (ATP) by Lohmann in 1928, there was, in A. V. Hill's words, "a revolution in muscle physiology". The important role of these phosphorus compounds in the contractile process and in glycolysis and the part played by the carbohydrate cycle in the resynthesis of phosphorus compounds have since been demonstrated by Lundsgaard, Parnass and others. The conception that energy associated with a chemical compound can be transferred without loss and utilised for work is a new one in modern physiology.

Though we have at the present day detailed information regarding the chemical changes in muscle, the essential nature of the contractile mechanism is still a mystery. What is the nature of the contractile element? How does the contractile element become active? Is the energy of contraction derived from the chemical stores or from the potential energy of the contractile element itself? Is chemical energy drawn upon for relaxation also? These are all questions that have to be answered to know exactly how a muscle works.

Szent Gyorgyi, Bio-chemist, University of Budapest, has, in his recent excellent monograph on "Chemistry of Muscular Contraction" dealt with these problems in a very lucid manner referring to the recent advances and incorporating the results of his own valuable research work on the subject. As an expert Bio-chemist, he has pulled 'the muscle fibre to pieces and has thrown much light on its exact composition and behaviour. He has attempted to link the chemical processes in muscle with the mechanical changes and has shown the intimate relationship between ATP and myosin, the chief protein in muscle. He describes that myosin itself, in combination with 'actin', a new protein discovered by F. B. Straub in 1942, shows enzymatic properties and acts on the adsorbed ATP in a narrow range of KCl concentration in the presence of Mg ions. The adsorption of ATP is dependent on K adsorption which in its turn depends on the previous adsorption of bivalent ions. Buchthal and others discovered in 1944 that ATP applied to

isolated muscle fibre produces twitches or tetanus. It is considered that under certain conditions the release of one single K ion may start the auto-catalytic release of the adsorbed ATP which sets up further changes. Possibly the ATP released in one muscle micel starts the process in its neighbour. According to Szent-Gyorgyi, the contracted state of 'actomyosin' is energy-poor and dehydrated, and in this state becomes enzymatically active, splits ATP and derives energy to go back to the energy-rich, hydrated, relaxed state.

Based on the recent findings of Boros and others about photo-electric effects and phosphorescence in a series of proteins caused by particular association of particles and establishment thereby of a common electronic band-structure stretching over the whole system, Szent-Gyorgyi puts forward a theory called 'the continuum theory' which, he considers, explains how 'actin', 'myosin', and prosthetic proteins, united into a complex, develop entirely new qualities of contractility or enzymatic activity and also how by the electron transport system the 'actomyosin' is linked to the 'oxidases' and 'dehydrogenases' which play a very important part in the oxidative reactions in muscle. He opines that 'the continuum theory' may take us even one step further into mysterious domains like that of origin of life.

The author deserves great credit for elucidating the intricate problems of muscle physiology in the light of recent research work and for introducing fresh ideas which, it is hoped, will stimulate further work on the subject. The monograph is a very valuable addition to the literature on muscle physiology.

B. T. KRISHNAN.

**Muscular Contraction.** *Annals of the New York Academy of Sciences*, Vol. XLVII, Art. 6, pp. 665-930.

This volume contains an interesting series of papers on the physiology of muscular contraction. It is divided into four parts. Part I deals with the dynamics of muscular contraction. The study of single muscle fibres presents a recent approach to the elucidation of the properties of muscular contraction. The comparison of rubber with muscle is interesting. At present we are ignorant of the chain of events which connect the muscle membrane and the contractile elements; the attempt, therefore, to point out at least one approach to this question, namely, the relationship between membrane changes and initiation and maintenance of contraction is interesting.

Part II contains articles on the ultrastructure of muscle. Birefringence, electron microscope, and X-ray diffraction studies contained therein offer their independent approaches to a visualisation of the ultrastructure of muscle, the structural basis of the muscle machine being of utmost importance for any theory of the contractile mechanism.

Part III contains articles on the latest views regarding the chemistry of muscular contraction,



Part IV deals with the problems of mechanochemical coupling, originating from the finding of Engelhardt and Ljubimova that myosin is itself an enzyme, and could no longer be regarded as an inert protein serving merely as the building blocks of the muscle fibril, but is, in all probability, a functional basis for the muscular activity.

Muscular contraction, however, still remains mysterious.

INDERJIT SINGH.

**Vegetable Growing.** By J. S. Shoemaker. (John Wiley & Sons, Inc., New York), 1947. Pp. 496 plus Index. Price \$4.50.

Vegetable growing is one of the important divisions of the science of Horticulture and is now conducted on a very large scale as a specialised type of farming rather than as mere gardening. In almost every country a great impetus was given to the cultivation of vegetables—particularly green vegetables whose health value is recognised—during the prolonged emergent conditions through which the whole world went through in recent years. The publication of the book under review is timely and very helpful as it pertinently acquaints the vegetable grower the application of such scientific principles and facts involved in successful production and maintenance of vegetable crops. Since a good vegetable cultivation primarily depends on the nature of the seed used, the author at the outset has laid a special emphasis on seed production practices so that there will be a better understanding of the fundamental factors involved in raising quality seeds. In the subsequent chapters (2-14) we are given a lucid and an eminently practical account of the different kinds of vegetables grouped as under:—Perennial vegetable crops, Corn crops, Root crops, Pulse, Bulb, Salad, Green and Cole crops, Potato, Sweet potato, Solanaceous fruits and Vine crops. An interesting historical account of most of the vegetables is given. The characteristics of the plant, the mode of planting, kind of soil, and the site necessary are described. Manures to be used and frequency of irrigation are indicated. Under cultivation and care, the pitfalls to be avoided and the essential cultural practices are clearly explained. The process of harvesting, the preparation for marketing are enumerated. The common diseases and pests to which each vegetable is prone are mentioned and remedial measures suggested.

The book is extremely well got up and is of that high standard that one has come to expect of its publishers. *Vegetable Gardening* is profusely illustrated, contains a good index and a number of references. Prof. Shoemaker has succeeded in making *Vegetable Growing* both a science and an art. The book should prove to be a welcome companion to vegetable growers and more especially to students of horticulture.

L. S. D.

**The Nature and Prevention of the Cereal Rusts as Exemplified in the Leaf Rust of Wheat.** By Chester K. Starr. (Waltham, Mass.: The Chronica Botanica Co. Calcutta; Macmillan & Co., Ltd.), 1947. Pp. xvi + 270. Price \$5.00.

This book came to our hands at a time when the rusts had taken a heavy toll on the Indian

wheat crop. As the title indicates, the book is a monograph on *Puccinia triticina*; it is a welcome addition to the literature on rusts. Those who have not had an occasion to go through the Russian monograph by Naumov will find in Prof. Chester's work all that one needs to know about the rust, including the more complicated aspects of rust control and breeding for rust resistance. The time was indeed ripe for such a monograph, not only on the brown rust but also on black and yellow. The author has admirably filled in the first gap and told a coherent story of the rust, many parts of which throw an illuminating light on the rust problem in general.

The author approaches the rust problem from the standpoints of a botanist, plant pathologist and plant breeder, with exceptional documentation on the leaf rust. The study begins with a short description of the origin and history of the cereal rusts and surveys the economic importance of the leaf rust in more than forty countries. It seems desirable that the paramount importance of this rust as concluded from Table I may be supported by similar tabulation of comparable data with regard to the yellow and, especially, the black rusts. Then follows a mass of information on the outstanding developments in the various aspects of rusts and on our understanding of the etiology, symptomatology, physiological specialization, rust survival, and rust control by fungicides as well as by the development of inherent rust resistance. More than three decades ago, experimental pathologists established the fundamental technique of the study of the physiological specialization of rusts; their work revealed the existence of physiologic races and opened the way for further advances by mycologists, geneticists and biochemists. In the two chapters on physiological specialization are discussed the concept of Geshele's "Isoreagent", the mesothetic reaction and refinements of the differential host technique with regard to the various factors influencing the host and pathogen in the determination of biologic races. Among the main recommendations are the advisability of adopting standard cultural conditions in rust analysis, maintaining an international collection of type cultures, and eliminating the three unstable of the eight differentials for brown rust analysis which would result in reducing the number of races of this rust from 129 to 44. Plant breeders will find of particular interest the evidence given in favour of the environmentally conditioned race groups. It is, however, recognised that the problem of breeding for rust resistance is complicated by the shifting nature of rust races and advent of new ones. The position will improve only when, as recently suggested by Stakman, are discovered the scientific principles underlying the prediction of potential races.

The monograph on the whole is an authoritative account of the rust problem as it stands to-day. The tables, the method of presenting the data, the readability, and the unusually good indexes add to the quality of the monograph. It is comprehensive and has covered the important work done in this country. India became rust-minded a generation ago, thanks to the work initiated by Mehta; and a co-operative breeding programme was started later by

Pal and Mehta. In the present state of our knowledge breeding for rust resistance and extending acreages under rust-resistant varieties seems to be the only suitable means of defence in most of the wheat belt. Prof. Chester has adduced evidence from India, Russia and other countries to show that rust uredospores can travel over great distances, sometimes over 1,000 miles, and has rightly pointed out that this is an international problem which can only be solved by international co-operation. We are in an age when the value of team-work for solving urgent scientific problems is increasingly clear. It is to be hoped that an international organization, as for instance, the Food and Agriculture Organization of the United Nations, which has kindled so many hopes in recent times, will take up this problem and bring a solution to it for the benefit of the world's population.

G. T. KALE.

Report of the Scientific Advisory Board of the Indian Research Fund Association for the Year ending 31st December 1946. (The Secretary, Governing Body, Indian Research Fund Association Secretariat, New Delhi.) Price Re. 1.

The Report is an interesting record of work on various subjects of medical and public health importance including nutrition.

Notable contribution has been made to malaria problems by experimental transmission of Simian Malaria *P. cynomolgi* to *Macaca muleta* monkey at Kasauli Institute to a number of species of anopheline mosquitoes which were experimentally infected.

On the therapeutical side paludrine has been found far superior to mepacrine, and in the case of malignant tertian malaria by suitable dosage the disease can be completely cured or effectively prevented.

It has been exclusively shown that in neuro-leprosy nasal smears show *M. lepræ* in much smaller proportion than skin smears, this is contrary to accepted notion. Promin and dione, two sulpha drugs, have given encouraging results in the treatment of leprosy in the hands of Dharmendra.

Casein hydrolysate vaccine for plague prophylaxis is found to have better keeping qualities than vaccine prepared by other methods and, therefore, it has longer expiry date. Among plague-prevention measures cynogas are more effective than D.D.T. to kill rats and fleas.

Radhakrishna Rao has evidence to suggest the role of low protein diet combined with vitamin B<sub>6</sub> complex deficiency as causative factor in infantile cirrhosis.

Clinical studies of Kutumbaiah indicate that the disease is more prevalent among children of low income group without any distinction of community. Cow's milk seems to play a part in the causation.

Lowe's finding of hypoproteinemia in Kala azar is of diagnostic significance. Similar condition has also been noted in diseases of the liver and tropical Eosinophilia. It has been observed that the protective power conferred by vaccinia virus cultivated in egg membrane is of shorter duration than that conferred by ordinary calf lymph. But during the period of protection there was no incidence of smallpox in an epidemic of smallpox in a village

where two groups of children were vaccinated one group with calf lymph and the other with membrane lymph.

Pyrethrin content of pyrethrum flower grown in different localities of Kashmir and dried by different methods has been studied with valuable findings by Chopra. The same author has made important observation on the deterioration of tincture digitales and powdered digitales leaves.

On the side of nutrition extensive work has been done. Ghosh in Calcutta states that vitamin C synthesis by rat will depend on the availability of thiamin and riboflavin in the system. Vitamin B complex deficiency is said to be the commonest form of malnutrition observed among patients in Madras hospitals, the clinical manifestations of which are various. Rapid improvement has been observed in cases of anaemia, oedema and cirrhosis of liver when treated with high protein diet. Muscle protein has been found to raise haemoglobin and R.B.C. level higher than by liver protein. Properly prepared soya milk fortified with calcium and yeast has been credited to be superior to cow's milk as a supplement to poor rice diet. The vitamin content of pure-bred cereals has been shown to be greater. This finding emphasises the influence of genetic factor over the environmental factor in the determination of quality of cereals.

K. P. M.

Journal of Indian Medicine (Quarterly Journal) Nandakutti Bldgs., Beasant Avenue, Adyar, Madras-20). Annual Subscription Rs. 3.

The first number of this Journal, published from Madras, is commended to those of the medical profession interested in ancient medicine. The Journal begins with a descriptive definition of Ayurveda. There are interesting articles on anaemia and fevers. There is a treatise on the treatment of snake-bite besides a few clinical notes by practitioners. It is hoped that the Journal will prove to be an useful contribution to the advancement of the indigenous medicine which is now being revived.

K. P. M.

Heredity. An International Journal of Genetics. (Oliver & Boyd Ltd.), 1947. Annual Subscription 40 sh.

The advances in Genetics during recent years have been phenomenal. This is not surprising since Genetics to-day fascinates not only the biologist and the statistician but also the chemist, the bacteriologist and the physicist as well. Originating as a branch of biology, it has become a science in itself. In fact specialization in certain directions in this field has gone so far that workers in other branches may find it difficult to follow and appreciate the recent advances.

But the increased interest in Genetics has not been accompanied by an increase in the number of Journals specially devoted for contributions on the subject. We have much pleasure, therefore, in welcoming the first number of *Heredity*, published thrice a year, edited by Dr. C. D. Darlington and Prof. R. A. Fisher in collaboration with a number of leading Geneticists. If the contributions expected to appear in the succeeding issues are any indication, the Journal has a promising future.

M. K. SUBRAMANIAM.

## SCIENCE NOTES AND NEWS

### Jubilee of the Electron

The Indian branch of the Institute of Physics (London) and of the Electrical Engineering Society, Bangalore, celebrated the Jubilee of the discovery of the electron at the Indian Institute of Science, Bangalore, on the 25th and 26th September. The celebrations were organised by the President, Sir C. V. Raman. On the 25th evening addresses were delivered by Sir C. V. Raman on the "Discovery of the Electron" and by Prof. R. G. Harris on "Reminiscences of Sir J. J. Thompson" under the presidency of Sir J. C. Ghosh. On the second day Sir C. V. Raman spoke in detail about the recent developments in the application of electron with reference to Radar, Electron Microscopy and Television, and Prof. R. G. Harris presided.

### Indian Archives

The National Archives of India (Imperial Record Department) has taken up the publication of an illustrated quarterly journal entitled the *Indian Archives* for the dissemination of information on archival and library matters.

The object of the journal is to pool up the knowledge on the use and preservation of historical material and render it accessible to a wider circle of readers who may find it useful. The quarterly will, on the one hand, serve as an organ for the furtherance of improvements in the field of archives-keeping by publishing the results of research by specialists in the subject and on the other help to keep all those interested in the science informed of the latest contributions made to it in the progressive countries outside India. One entire section of the journal will be devoted to publishing extracts or translations of significant articles on the subject in foreign languages not easily accessible to Indian readers.

### Tin and Its Uses

The use of an extremely thin coating of tin (0.00005" thick) on mild steel before painting is found to provide an exceptionally good rust-resisting combination. An even more important finding is that the pre-tinned specimens have retained a clean tinned surface which is free from rust and can be re-painted without preliminary scraping and cleaning operations whereas the surfaces of the untinned steels rust underneath the paint. The use of pre-tinned steel would do much to improve the appearance and prolong the life of motor car body-work and other painted steel products. The costs involved in applying an undercoating of tin, of the recommended thickness (0.00003-0.00005 inch), to both surfaces of a sheet of steel are estimated at less than a quarter of the charges for labour and materials required to apply a single coat of paint to only one side of the sheet.

Tin and Its Uses, No. 18, may be obtained free of charge on application to the Tin Research Institute, Fraser Road, Greenford, Middlesex, and in the United States from the Battelle Memorial Institute, 505, King Avenue, Columbus, Ohio.

### Exhibition of Deep Pictures

A very interesting exhibition of three-dimensional photography was held at the London Exhibition Centre recently. On view were a number of flat photographs which give to the spectator a very effective three-dimensional impression of various subjects without the use of any of the apparatus used with ordinary stereoscopic photography. So effective is the illusion of depth, that one has the impression of looking at a sculptured model; one can even appear to put one's finger behind an apparently protruding part of a picture.

The process operates with the help of ordinary photographic materials, with the addition of a grid comprising a special lenticular optical system, and the prints are apparently only slightly more expensive than orthodox first-class studio pictures. The photographs on view illustrated a variety of subjects ranging from studio-portraits to microphotographs of insects and wrist-watch movements. The applications of this new invention may be wide.

### Portable Hydrogen Generator

A portable apparatus for generating hydrogen has been designed by the Meteorological Department of India. This generator makes hydrogen available at mobile observatory stations for pilot-balloon observations.

This generator uses the silico-soda process for production of hydrogen. Charges of Ferro-silicon corresponding to the quantity of Soda are dropped at intervals of 4 to 5 minutes through a special receptacle on the top of the generator. Leakage is avoided by the use of suitable gaskets and glands, and the gas is washed in a scrubber to which the balloon to be filled is attached. This is a portable apparatus that lends itself, unlike hydrogen cylinders, to easy transport to outlying and mountainous stations.

### Pilotless Flying

The United States Air Force announced that a four-engined C-54 Skymaster has completed the first trans-Atlantic flight in history without a pilot at the controls.

The transport plane took off from Stephenville, Newfoundland, at 11 p.m. (B.S.T.) on Sunday and landed at Mrisenorton, England, a distance of about 2,400 miles, ten hours fifteen minutes later.

The Skymaster was guided by a "mechanical brain", known to be the only one in existence. The mechanism involves time sequences and a radio beam.

The Skymaster was commanded by Colonel Gillin-Sill. The plane picked up a local frequency at Brisenorton, Oxfordshire, England, after which it set down its landing gear automatically and made an automatic landing. The "Pilotless" flight of the Skymaster is said to be an important step towards "push-button" warfare.

### Digest of Articles on Diamonds

The Industrial Diamond Information Bureau, Industrial Distributors (1946) Ltd., St. Andrew's House, 32-34, Holborn Viaduct, London, E.C. 1,



publishes monthly a bulletin containing abstracts of articles dealing with properties and industrial applications of diamond: together with notices of patents and patent applications in many States. A copy of this bulletin may be obtained, free of charge, on application to the above address.

#### Gammexane for Termites

Mr. Gulvadi reports in the *Indian Forester* his trials on the successful eradication of white-ant infestations in buildings and colonies in mounds with Gammexane D 025 (powder) and LG 140 (liquid). A single application of the compound is said to be permanently effective against the insect pest.

#### UBESCO

In his convocation address to the Calcutta University, Sir J. C. Ghosh proposed the establishment of a United Bengal Educational, Scientific and Cultural Organisation, charged with the responsibility of maintaining the cultural unity of a divided Bengal. He felt confident that as our people began to enjoy freedom for some time, they will, no doubt, themselves proclaim that the interdependence of the various parts of India is essential for the rational solution of many problems that face the country.

#### New Paint Needs No Linseed Oil

A new, high-grade paint that contains no linseed oil has been developed by an English firm.

Apart from its not depending on the oil—the shortage of which has severely hampered British paint output since the end of the war—this water paint, which is called *Artoplast*, has several noteworthy features.

In the first place, it is extremely economical in use, having exceptional coverage powers. For example, an old, black wall-board can be covered with two coats of *Artoplast* with excellent results. Again, a ton of the paint covers half as much space again as one ton of distemper.

*Artoplast* is also washable, easy of application and possesses great flexibility. Exhaustive tests on canvas have shown that it neither cracks nor flakes.

The new paint is manufactured in twenty fast colours, but the manufacturers are also able to supply it in any desired shade for orders of over half-a-ton.

#### Andhra University

The M.Sc. degree of the Andhra University has been awarded to the following research scholars:—V. Ramakrishnamurti, T. S. G. Krishnamurti, R. V. G. Sundara Rao, P. V. Somayajulu, Bh. Krishnamurti, V. Venkateswarlu, G. Krishna Das, C. V. Suryanarayana, G. Gopalakrishna Sastri, Ch. Narasimha Rao, N. Gopalakrishnamurti, N. Venkatappayya, E. Venkayya and G. Venkateswara Rao.

#### Inter-National Congress on Large Dams

The Dominion of India will be one of the twenty countries of the world participating in the Third International Congress on Large Dams, which will begin on June 10, 1948, in Stockholm. The Central Board of Irrigation, Simla, is the National Committee of the Congress for India, to which intending participants from India should send their preliminary applications.

At the session of the Congress in Stockholm the National Committee will submit papers on the main questions included in the

Agenda of the Congress. It will submit also other communications, which may be of interest to the members of the Congress, though not for the purpose of discussion.

It is also understood that the International Association for Hydraulic Structures Research will hold its meeting in Stockholm from June 7 to 9, 1948. And after the termination of the session of the Third International Congress on Large Dams, the meeting of the International Conference on Soil Mechanics and Foundation Engineering will take place. This will be held at Rotterdam from June 21 to 30, 1948.

#### Nobel Prize for Medicine

Dr. Carl F. Cori and Mrs. Cori have been jointly awarded half of the Nobel Prize for Medicine. Dr. Cori is Professor of Pharmacy and Bio-Chemistry in Washington University and his wife is an Associate Professor. The Coris have done work in research on carbohydrate metabolism and the enzymes of animal tissues. They were advised of the award by cable from Stockholm before the announcement was actually made in Stockholm, but the cable did not say which of their discoveries was the basis of the award.

Dr. Bernardo A. Houssay, physiologist of Buenos Aires, has been awarded the other half of the Prize. He has worked on internal secretions, including the thyroid glands, as well as on diabetes.

#### Indian Economic Conference

The forthcoming session of the Indian Economic Conference in Calcutta on December 22, 23 and 24 will be inaugurated by the Governor of West Bengal, Mr. C. Rajagopalachari.

This will be on the morning of the 22nd. It will be followed by an address of welcome by Mr. P. N. Banerjee, Vice-Chancellor of the Calcutta University, and the Presidential Address by Dr. P. S. Lokanathan.

The afternoon session will be devoted to a discussion on cheap money policy. On the next two days, there will be discussions on "Commercial Policy for India" and "Problems of Agricultural Labour". A symposium is being organised by the Reception Committee on State and Nationalisation, over which Mr. N. R. Sarkar will preside.

#### Dr. Fred Marsden, M.Sc., Ph.D.

News has just been received of the passing of Dr. Fred Marsden, at one time Dye and Colour Expert to the Government of Madras.

Dr. Marsden was a native of Manchester (England) and studied chemistry at Owens College in the days of Sir Henry Roscoe. He graduated M.Sc. and later (1890) became a student in Heidelberg, Germany, under Victor Meyer and there attained his Ph.D.

Later he acquired extended experience in the technology of the colour industry, and during World War I was appointed Dye and Colour Expert to the Government of Madras. During that time his headquarters were transferred to the Department of Biochemistry at the Indian Institute of Science, Bangalore. There he rendered valuable help in the conduct of the Department and took part in some important researches notably on the biochemical problems of the Coir Industry.

After his retirement, Dr. and Mrs. Marsden lived happily at Budleigh Salterton, N. Devon, in their own house which was named "Hebbal" in memory of the old life at Bangalore.



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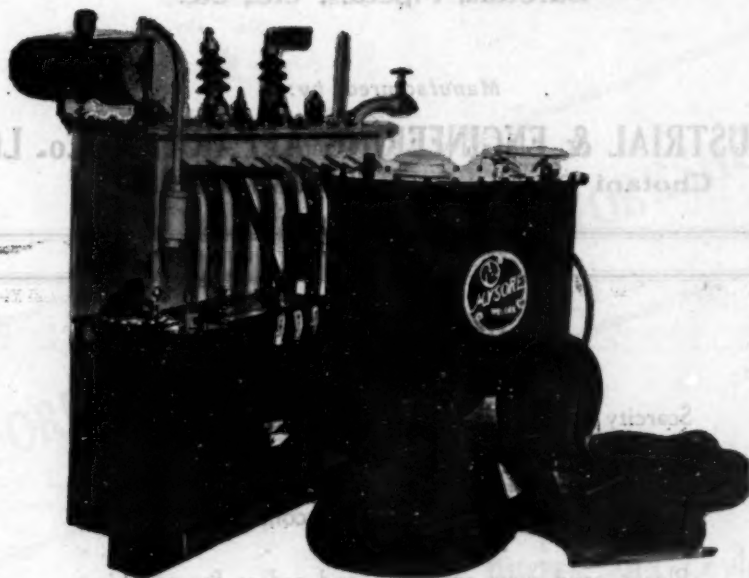


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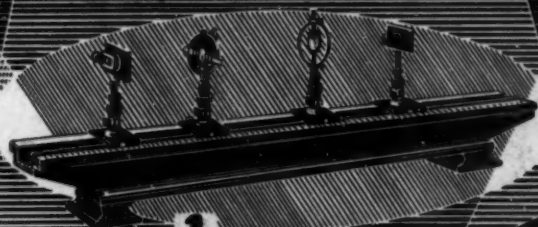
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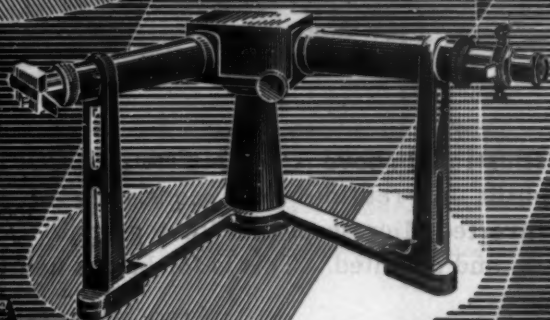
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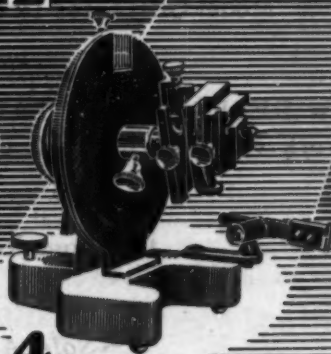
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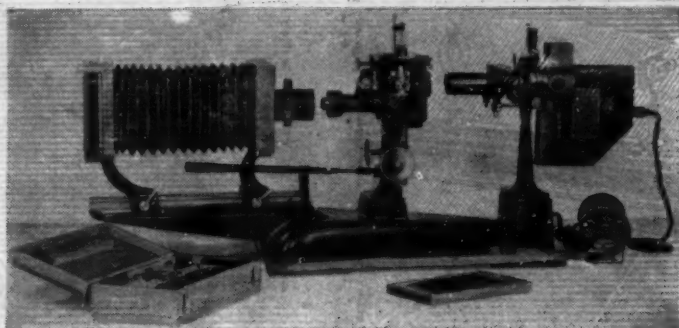
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